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(54) Title: COMPOSITION AND METHOD FOR TREATING PLANTS WITH EXOGENOUS CHEMICALS

(57) Abstract

A composition is disclosed for application to a plant that comprises an exogenous chemical (for example, a postemergent herbicide), an aqueous diluent, and a first excipient substance that is amphiphilic. The weight/weight ratio of the first excipient substance to the exogenous chemical is between about 1:3 and about 1:100. The aqueous composition forms anisotropic aggregates on a wax layer, and the presence of the anisotropic aggregates can be detected by a test described herein. Compositions of the present invention, when applied to plants, provide enhanced biological activity per unit amount of exogenous chemical, as compared to otherwise similar compositions containing surfactants that do not form anisotropic aggregates. Without being bound by theory, it is presently believed that this enhanced biological activity results from the formation or enlargement of hydrophilic channels through the epicuticular wax of the plant.

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COMPOSITION AND METHOD FOR TREATING PLANTS WITH EXOGENOUS CHEMICALS

BACKGROUND OF THE INVENTION

This invention relates to formulations and methods for enhancing the efficacy of exogenous chemicals used in treating plants. An exogenous chemical, as defined herein, is any chemical substance, whether naturally or synthetically derived, which (a) has biological activity or is capable of releasing in a plant an ion, moiety or derivative which has biological activity, and (b) is applied to a plant with the intent or result that the chemical substance or its biologically active ion, moiety or derivative enter living cells or tissues of the plant and elicit a stimulatory, inhibitory, regulatory, therapeutic, toxic or lethal response in the plant itself or in a pathogen, parasite or feeding organism present in or on the plant. Examples of exogenous chemical substances include, but are not limited to, chemical pesticides (such as herbicides, algicides, fungicides, bactericides, viricides, insecticides, aphicides, miticides, nematicides, molluscicides, and the like), plant growth regulators, fertilizers and nutrients, gametocides, defoliants, desiccants, mixtures thereof, and the like.

Exogenous chemicals, including foliar-applied herbicides, have at times been formulated with surfactants, so that when water is added, the resulting sprayable composition is more easily and effectively retained on the foliage (e.g., the leaves or other photosynthesizing organs) of plants. Surfactants can also bring other benefits, including improved contact of spray droplets with a waxy leaf surface and, in some cases, improved penetration of the accompanying exogenous chemical into the interior of leaves. Through these and perhaps other effects, surfactants have long been known to increase the biological effectiveness of herbicide compositions, or other compositions of exogenous chemicals, when added to or included in such compositions. Thus, for example, the herbicide glyphosate (N-phosphonomethylglycine) has been formulated with surfactants such as polyoxyalkylene-type surfactants including, among other surfactants, polyoxyalkylene alkylamines. Commercial formulations of glyphosate herbicide marketed under the trademark ROUNDUP® have been formulated with a surfactant composition based on such a polyoxyalkylene alkylamine, in particular a polyethoxylated tallowamine, this surfactant composition being identified as MON 0818. Surfactants have generally been combined with glyphosate or other exogenous chemicals either in a commercial concentrate (herein referred to as a "coformulation"), or in a diluted mixture that is prepared from separate compositions, one comprising an exogenous chemical (e.g. glyphosate) and another comprising surfactant, prior to use in the field (i.e., a tank mix).

Various combinations of exogenous chemicals and surfactants or other adjuvants have been tested in the past. In some instances, the addition of a particular surfactant has not produced uniformly positive or negative changes in the effect of the exogenous chemical on the plant (e.g., a surfactant that

may enhance the activity of a particular herbicide on certain weeds may interfere with, or antagonize, the herbicidal efficacy on another weed species).

Some surfactants tend to degrade fairly rapidly in aqueous solutions. As a result, surfactants that exhibit this property can only be used effectively in tank mixes (i.e., mixed with the other ingredients in solution or dispersion in the tank soon before spraying is to occur), rather than being coformulated in an aqueous composition with the other ingredients in the first instance. This lack of stability, or inadequate shelf-life, has hindered the use of certain surfactants in some exogenous chemical formulations.

Other surfactants, though chemically stable, are physically incompatible with certain exogenous chemicals, particularly in concentrate coformulations. For example, most classes of nonionic surfactant, including polyoxyethylene alkylether surfactants, do not tolerate solutions of high ionic strength, as for example in a concentrated aqueous solution of a salt of glyphosate. Physical incompatibility can also lead to inadequate shelf-life. Other problems that can arise from such incompatibility include the formation of aggregates large enough to interfere with commercial handling and application, for example by blocking spray nozzles.

Another problem that has been observed in the past is the effect of environmental conditions on uptake of an exogenous chemical composition into foliage of a plant. For example, conditions such as temperature, relative humidity, presence or absence of sunlight, and health of the plant to be treated, can affect the uptake of a herbicide into the plant. As a result, spraying exactly the same herbicidal composition in two different situations can result in different herbicidal control of the sprayed plants.

One consequence of the above-described variability is that often a higher rate of herbicide per unit area is applied than might actually be required in that situation, in order to be certain that adequate control of undesired plants will be achieved. For similar reasons, other foliar-applied exogenous chemicals are also typically applied at significantly higher rates than needed to give the desired biological effect in the particular situation where they are used, to allow for the natural variability that exists in efficiency of foliar uptake. A need therefore exists for compositions of exogenous chemicals that, through more efficient uptake into plant foliage, allow reduced use rates.

Many exogenous chemicals are commercially packaged as a liquid concentrate that contains a significant amount of water. The packaged concentrate is shipped to distributors or retailers. Ultimately the packaged concentrate ends up in the hands of an end user, who further dilutes the concentrate by adding water in accordance with label instructions on the package. The dilute composition thus prepared is then sprayed on plants.

A significant portion of the cost of such packaged concentrates is the cost of transporting the concentrate from the manufacturing site to the location where the end user purchases it. Any liquid concentrate formulation that contained relatively less water and thus more exogenous chemical would reduce the cost per unit amount of exogenous chemical. However, one important limit on the ability of the manufacturer to increase the loading of the exogenous chemical in the concentrate is the stability of

that formulation. With some combinations of ingredients, a limit will be reached at which any further reduction of water content in the concentrate will cause it to become unstable (e.g., to separate into discrete layers), which may make it commercially unacceptable.

Accordingly, a need exists for improved formulations of exogenous chemicals, particularly herbicides, that are stable, effective, less sensitive to environmental conditions, and permit the use of reduced amounts of exogenous chemical to achieve the desired biological effect in or on plants. A need also exists for stable liquid concentrate formulations of exogenous chemicals that contain less water and more exogenous chemical than prior art concentrates.

SUMMARY OF THE INVENTION

The present invention relates to novel methods and compositions wherein exogenous chemicals are applied to plants to generate a desired biological response.

One embodiment of the present invention is a method of applying an exogenous chemical to a plant, comprising the steps of (a) contacting foliage of the plant with a biologically effective amount of the exogenous chemical, and (b) contacting the same foliage with an aqueous composition that comprises a first excipient substance that is amphiphilic. The weight/weight ratio of said first excipient substance to the exogenous chemical is between about 1:3 and about 1:100. Further, the aqueous composition forms anisotropic aggregates in or on a wax layer as explained below. "Contacting" in this context means placing the substance or composition on the foliage. "Amphiphilic" means having at least one polar, water-soluble head group which is hydrophilic and at least one water-insoluble organic tail which is hydrophobic, contained within the same molecule.

In this method, step (b) can occur simultaneously with or within about 96 hours before or after step (a). In embodiments of the method in which the two steps occur simultaneously, either the exogenous chemical and the aqueous composition can be applied to the plant separately, for example by two spray nozzles directed at the same foliage, or the exogenous chemical can be contained within the aqueous composition, for example in a tank mix or coformulation.

Formation of anisotropic aggregates in or on a wax layer is determined by a test described in detail subsequently herein. In general, the test, as it applies to a composition comprising an exogenous chemical, comprises the steps of (1) providing a glass microscope slide coated with a thin, uniform layer of wax, such that the wax layer on the slide exhibits a dark field when illuminated by transmitted polarized light and examined through a microscope, (2) preparing a sample of an aqueous solution or dispersion of the composition to be tested, diluted or concentrated if necessary such that the concentration of exogenous chemical is about 15% to about 20% by weight of the composition, (3) positioning the wax-coated slide on the stage of a microscope that transmits polarized light through the slide, (4) placing a drop of the sample on the wax on the slide to form an assay slide, (5) maintaining the assay slide at approximately ambient temperature for a period of about 5 to about 20 minutes, and (6) determining, at the end of that period, whether when transmitting polarized light the locus of the drop on

the slide displays birefringence. Birefringence at 5-20 minutes indicates the presence of anisotropic aggregates in or on the wax layer, while the absence of birefringence at that time indicates the absence of anisotropic aggregates as defined herein.

The test, as it applies to an aqueous composition of one or more excipient substances, not itself containing an exogenous chemical but intended for application to foliage of a plant in conjunction with an exogenous chemical, is as just described, except that in step (2) the composition is diluted or concentrated so that the concentration of the first excipient substance is approximately 5% to 7% by weight.

An "excipient substance" as that term is used in this patent is any substance other than an exogenous chemical and water that is added to the composition. "Excipient substances" include inert ingredients, although an excipient substance useful in the present invention does not have to be devoid of biological activity.

Another embodiment of the present invention is a plant treatment composition comprising (a) an exogenous chemical, and (b) a first excipient substance that is amphiphilic. As described above, the weight/weight ratio of said first excipient substance to the exogenous chemical is between about 1:3 and about 1:100, and in presence of water said composition forms anisotropic aggregates in or on a wax layer. This composition can be used in a method of treating plants, in which foliage of the plant is contacted with a biologically effective amount of a composition as described above and further comprising an aqueous diluent.

A wide variety of exogenous chemicals can be used in the compositions and methods of the present invention. A preferred class is foliar-applied exogenous chemicals, i.e. exogenous chemicals that are normally applied post-emergence to foliage of plants. A preferred subclass of foliar-applied exogenous chemicals is those that are water-soluble. By "water-soluble" in this context is meant having a solubility in distilled water at 25°C greater than about 1% by weight. Especially preferred water-soluble exogenous chemicals are salts that have an anion portion and a cation portion. In one embodiment of the invention, at least one of the anion and cation portions is biologically active and has a molecular weight of less than about 300. Particular examples of such exogenous chemicals where the cation portion is biologically active are paraquat, diquat and chlormequat. More commonly it is the anion portion that is biologically active.

Another preferred subclass of exogenous chemicals is those that exhibit systemic biological activity in the plant. Within this subclass, an especially preferred group of exogenous chemicals is N-phosphonomethylglycine and its herbicidal derivatives. N-phosphonomethylglycine, often referred to by its common name glyphosate, can be used in its acid form, but is more preferably used in the form of a salt. Any water-soluble salt of glyphosate can be used in the practice of this invention. Some preferred salts include the sodium, potassium, ammonium, mono-, di-, tri- and tetra-C_{1-4}-alkylammonium, mono-, di- and tri-C_{1-4}-alkanolammonium, mono-, di- and tri-C_{1-4}-alkylsulfonium and sulfoxonium salts. The

ammonium, monoisopropylammonium and trimethylsulfonium salts of glyphosate are especially preferred. Mixtures of salts can also be useful in certain situations.

A composition of the present invention comprising an exogenous chemical and a first excipient substance as described above can have a number of different physical forms. For example, the composition can further comprise water in an amount effective to make the composition a dilute aqueous composition ready for application to foliage of a plant. Such a composition typically contains about 0.02 to about 2 percent by weight of the exogenous chemical, but for some purposes can contain up to about 10 percent by weight or even more of the exogenous chemical.

Alternatively, the composition can be a shelf-stable concentrate composition comprising the exogenous chemical substance in an amount of about 10 to about 90 percent by weight. By "shelf-stable" in this context it is meant that the composition does not exhibit phase separation when stored at ambient temperature for a period of time dependent on the particular circumstances. Such shelf-stable concentrates can be, for example, (1) a solid composition comprising the exogenous chemical substance in an amount of about 30 to about 90 percent by weight, such as a water-soluble or water-dispersible granular formulation, or (2) a composition that further comprises a liquid diluent, wherein the composition comprises the exogenous chemical substance in an amount of about 10 to about 60 percent by weight. In this latter embodiment, it is especially preferred for the exogenous chemical substance to be water-soluble and present in an aqueous phase of the composition in an amount of about 15 to about 45 percent by weight of the composition. In particular, such a composition can be, for example, an aqueous solution concentrate or an emulsion having an oil phase. If it is an emulsion, it can more specifically be, for example, an oil-in-water emulsion, a water-in-oil emulsion, or a water-in-oil-in-water multiple emulsion. In one particular embodiment of the invention, the solid or aqueous composition further comprises a solid inorganic particulate colloidal material.

As described above, one embodiment of the invention is a sprayable composition having the property that it forms anisotropic aggregates in or on a wax layer. This composition comprises an exogenous chemical, an aqueous diluent, and a first excipient substance which is amphiphilic. In the sprayable composition, the weight/weight ratio of the first excipient substance to the exogenous chemical is between about 1:3 and about 1:100. A sprayable composition conforms to this embodiment of the invention even if the formation of anisotropic aggregates in or on a wax layer occurs only following concentration of the composition on the wax layer by evaporation of water. The term "spray composition" is sometimes used herein to mean a sprayable composition.

In a related embodiment of the invention, a concentrate composition is provided which, upon dilution, dispersion or dissolution in water forms the sprayable composition just described. The concentrate composition contains a reduced amount of the aqueous diluent, or, in a particular embodiment, is a dry composition having less than about 5% water by weight. Typically a concentrate

composition of the invention contains at least about 10% by weight of the exogenous chemical, preferably at least about 15%.

An alternative embodiment is a composition that does not itself comprise an exogenous chemical, but is intended for application to a plant in conjunction with or as a carrier for the application of an exogenous chemical. This composition comprises a first excipient substance as described above. Such a composition may be sprayable, in which case it also comprises an aqueous diluent, or it may be a concentrate, requiring dilution, dispersion or dissolution in water to provide a sprayable composition. Thus, this embodiment of the invention can be provided as a stand-alone product and applied to a plant, diluted as appropriate with water, simultaneously with the application of an exogenous chemical, or before or after the application of the exogenous chemical.

In all embodiments, it is believed that the first excipient substance forms supramolecular aggregates in aqueous solution or dispersion. In particular it is believed that aqueous compositions of the present invention form aggregates in aqueous solution or dispersion the majority of which are not simple micelles. "Majority" means that more than 50% by weight of the first excipient substance present is in the form of complex aggregates other than simple micelles, e.g. as bilayers or multilamellar structures. Preferably, more than 75% by weight is in the form of complex aggregates other than simple micelles.

Whether or not an amphiphilic substance forms such aggregates depends on its molecular architecture. The effects of molecular architecture on supramolecular self-assembly of amphiphilic molecules, as set forth for example by J. N. Israelachvili, D. J. Mitchell and B. W. Ninham in Faraday Transactions II, Volume 72, pp. 1525-1568 (1976) and in numerous later articles and monographs, are well known and understood. An important aspect is "critical packing parameter" (P) which is defined in the literature by the following equation:

$$P = V / lA$$

where V is the volume of the hydrophobic tail of the molecule, l is the effective length of the hydrophobic tail, and A is the area occupied by the hydrophilic headgroup. These dimensions can be calculated from physical measurements as described in the literature and have been published for numerous amphiphilic compounds.

It is believed that amphiphilic substances useful as the first excipient substance herein have a critical packing parameter greater than 1/3. The first excipient substance forms aggregates in aqueous solution or dispersion which preferably have at least one dimension that is greater than two times the molecular length of the first excipient substance.

In one embodiment of the invention, an aqueous composition comprises supramolecular aggregates of the first excipient substance which have an average diameter of at least 20 nm, preferably at least 30 nm.

These supramolecular aggregates can take a number of forms. In one preferred embodiment, the first excipient substance is a vesicle-forming amphiphilic substance, such as a vesicle-forming lipid, and

when the substance is dispersed in water the majority (greater than 50% by weight, preferably greater than 75% by weight) of the first excipient substance is present as vesicles or liposomes. In another preferred embodiment the first excipient substance is present as bilayers or multilamellar structures which are not organized as vesicles or liposomes. Compositions of the present invention can also include, without limitation, colloidal systems such as emulsions (water/oil, oil/water, or multiple, e.g., water/oil/water), foams, microemulsions, and suspensions or dispersions of microparticulates, nanoparticulates, or microcapsules. Compositions of the invention can include more than one type of aggregate or colloidal system; examples include liposomes or vesicles dispersed in a microemulsion, and compositions having characteristics of both emulsions and suspensions, e.g. suspo-emulsions. The present invention also encompasses any formulation, which may or may not contain a significant amount of water, that on dilution in an aqueous medium forms such colloidal systems, and/or systems comprising vesicles, liposomes, bilayers or multilamellar structures, so long as the other requirements stipulated herein are met.

The weight ratio of the first excipient substance to the exogenous chemical is between about 1:3 and about 1:100. We have been surprised by the high level of biological effectiveness, specifically herbicidal effectiveness of a glyphosate composition, exhibited at such low ratios of excipient substance to exogenous chemical. Higher ratios can also be effective but are likely to be uneconomic in most situations and increase the risk of producing an antagonistic effect on effectiveness of the exogenous chemical.

Prior art exogenous chemical compositions that have included liposome-forming excipient substances have typically contained a higher percentage of the liposome-forming excipient substance than of the exogenous chemical. Compositions of the present invention, in contrast, contain less of the excipient substance than the exogenous chemical, and in some embodiments much less. This makes the compositions of the present invention much less expensive than the above-described prior art compositions. It is surprising that the enhancement of biological activity that has been observed when using the present invention can be achieved with the addition of relatively small amounts of such excipient substances.

In one embodiment of the invention the first excipient substance is a liposome-forming material that comprises an amphiphilic compound or mixture of such compounds having two hydrophobic moieties, each of which is a saturated alkyl or acyl chain having from about 8 to about 22 carbon atoms. The amphiphilic compound or mixture of such compounds having said two hydrophobic moieties with about 8 to about 22 carbon atoms constitutes from about 40 to 100 percent by weight of all amphiphilic compounds having two hydrophobic moieties present in the liposome-forming material. Preferably the liposome-forming material has a hydrophilic head group comprising a cationic group. More preferably, the cationic group is an amine or ammonium group.

In a preferred embodiment of the invention, the first excipient substance comprises a liposome-forming compound having a hydrophobic moiety comprising two saturated or unsaturated hydrocarbyl groups R^1 and R^2 each having about 7 to about 21 carbon atoms. A number of subclasses of such liposome-forming compounds are known.

One subclass has the formula

$$N^+(CH_2R^1)(CH_2R^2)(R^3)(R^4)\ Z^- \qquad \text{I}$$

wherein R^3 and R^4 are independently hydrogen, C_{1-4} alkyl or C_{1-4} hydroxyalkyl and Z is a suitable anion.

A second subclass has the formula

$$N^+(R^5)(R^6)(R^7)CH_2CH(OCH_2R^1)CH_2(OCH_2R^2)\ Z^- \qquad \text{II}$$

wherein R^5, R^6 and R^7 are independently hydrogen, C_{1-4} alkyl or C_{1-4} hydroxyalkyl and Z is a suitable anion.

A third subclass has the formula

$$N^+(R^5)(R^6)(R^7)CH_2CH(OCOR^1)CH_2(OCOR^2)\ Z^- \qquad \text{III}$$

wherein R^5, R^6, R^7 and Z are as defined above.

A fourth subclass has the formula

$$N^+(R^5)(R^6)(R^7)CH_2CH_2\text{-}PO_4^-\text{-}CH_2CH(OCOR^1)CH_2(OCOR^2) \qquad \text{IV}$$

wherein R^5, R^6, and R^7 are as defined above.

Compounds of formulas I-IV will have the indicated formulas at a pH of 4 and may have the same formulas at other pH's as well. It should be understood, however, that compositions of the present invention are not limited to use at a pH of 4.

R^1 and R^2 preferably are independently saturated straight-chain alkyl groups each having about 7 to about 21 carbon atoms. Examples of suitable agriculturally acceptable anions Z include hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate.

In all of the above subclasses of liposome-forming substances, the hydrophilic moiety comprises a cationic group, specifically an amine or ammonium group. The compound as a whole is in some cases cationic (as in I, II and III) and in some cases neutral (as in IV). Where the amine group is quaternary, it behaves as a cationic group independently of pH. Where the amine group is secondary or tertiary, it behaves as a cationic group when protonated, i.e. in an acid medium, for example at a pH of 4.

In a preferred embodiment, the first excipient substance is a phospholipid selected from the group consisting of di-C_{8-22}-alkanoylphosphatidylcholines and di-C_{8-22}-alkanoylphosphatidylethanolamines. In a particularly preferred embodiment, the first excipient substance is a dipalmitoyl or distearoyl ester of phosphatidylcholine or a mixture thereof.

Other subclasses of liposome-forming substances having two hydrophobic chains each comprising a C_{7-21} hydrocarbyl group can also be used as the first excipient substance in compositions of the invention. While substances having a cationic group in the hydrophilic moiety are preferred, nonionic or anionic substances can be used if desired.

In another embodiment of the invention, the first excipient substance is an amphiphilic quaternary ammonium compound or mixture of such compounds. The hydrophobic moiety of the quaternary ammonium compound is a saturated alkyl or haloalkyl group having about 6 to about 22 carbon atoms. In this embodiment, the first excipient substance is not necessarily a liposome-forming substance, but it is believed to form aggregates in aqueous solution or dispersion as described above.

Preferred quaternary ammonium compounds (other than those which are liposome-forming and have two hydrocarbyl chains) for use as the first excipient substance in compositions of the invention have the formula

$$R^8\text{-}W_a\text{-}X\text{-}Y_b\text{-}(CH_2)_n\text{-}N^+(R^9)(R^{10})(R^{11})\ T^- \qquad \text{V}$$

wherein R^8 represents the hydrophobic moiety and is a hydrocarbyl or haloalkyl group having from about 6 to about 22 carbon atoms, W and Y are independently O or NH, a and b are independently 0 or 1 but at least one of a and b is 1, X is CO, SO or SO_2, n is 2 to 4, R^9, R^{10} and R^{11} are independently C_{1-4} alkyl, and T is a suitable anion. R^8 in one particular embodiment is hydrocarbyl having about 12 to about 18 carbon atoms. R^8 can also be fluorinated. In one specific embodiment, R^8 is perfluorinated, and preferably has about 6 to about 12 carbon atoms. Suitable anions T include hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate. In one particularly preferred embodiment, R^8 is saturated perfluoroalkyl having about 6 to about 12 carbon atoms, X is CO or SO_2, Y is NH, a is 0, b is 1, n is 3, R^9, R^{10} and R^{11} are methyl, and T is selected from the group consisting of chloride, bromide and iodide.

In a further embodiment of the invention, the first excipient substance is an alkylether surfactant or mixture of such surfactants having the formula

$$R^{12}\text{-O-}(CH_2CH_2O)_n(CH(CH_3)CH_2O)_m\text{-}R^{13} \qquad \text{VI}$$

wherein R^{12} is an alkyl or alkenyl group having about 16 to about 22 carbon atoms, n is an average number of about 10 to about 100, m is an average number of 0 to about 5 and R^{13} is hydrogen or C_{1-4} alkyl. Preferably R^{12} is a saturated straight-chain alkyl group, R^{13} is hydrogen, m is 0 and n is from about 10 to about 40, more preferably from about 20 to about 40. Most preferably the alkylether surfactant is a polyoxyethylene cetyl or stearyl ether or mixture thereof having 20-40 moles of ethylene oxide (EO). The term "alkylether" as used herein should be understood to include alkenylether surfactants.

Compositions of the present invention can optionally further comprise a second excipient substance having at least one hydrophobic moiety, wherein if the second excipient substance has one hydrophobic moiety, the hydrophobic moiety is a hydrocarbyl or haloalkyl group having about 6 to about 22 carbon atoms, and wherein if the second excipient substance has a plurality of hydrophobic moieties, each such hydrophobic moiety is a hydrocarbyl or haloalkyl group having more than 2 carbon atoms, said plurality of hydrophobic moieties having a total of about 12 to about 40 carbon atoms. The second excipient substance, if present, may or may not itself be one that forms supramolecular aggregates as

described above. In a particular embodiment of the invention where the first excipient substance is a liposome-forming substance of formula I, II, III or IV above, a second excipient substance is present and is a quaternary ammonium compound or mixture of such compounds. Among preferred quaternary ammonium compounds for use as the second excipient substance in this embodiment are compounds of formula V above.

In another particular embodiment of the invention where the first excipient substance is a liposome-forming substance of formula I, II, III or IV above, a second excipient substance is present and is a compound or mixture of compounds of formula

$$R^{14}\text{-CO-A-}R^{15} \qquad \text{VII}$$

wherein R^{14} is a hydrocarbyl group having about 5 to about 21 carbon atoms, R^{15} is a hydrocarbyl group having 1 to about 14 carbon atoms, the total number of carbon atoms in R^{14} and R^{15} is about 11 to about 27, and A is O or NH.

R^{14} preferably has about 11 to about 21 carbon atoms, R^{15} preferably has 1 to about 6 carbon atoms and A is preferably O. More preferably, the second excipient substance is a C_{1-4} alkyl ester of a C_{12-18} fatty acid, for example a propyl, isopropyl or butyl ester of a C_{12-18} fatty acid. Butyl stearate is an especially preferred example. The aqueous composition in embodiments comprising a compound of formula VII preferably is an emulsion comprising an oil phase that comprises said second excipient substance, for example a water-in-oil-in-water multiple emulsion or an oil-in-water emulsion. Alternatively, a second excipient substance of formula VII is associated in some way with a liposome-forming first excipient substance.

In yet another particular embodiment of the invention, the first excipient substance is an alkylether surfactant of formula VI and a second excipient substance is present and is a compound or mixture of compounds of formula VII.

In any of the above particular embodiments, the exogenous chemical and/or second excipient substance can be encapsulated within or associated with aggregates (e.g., liposomes) formed by the first excipient substance, but do not necessarily have to be so encapsulated or associated. "Associated" in this context means bound to or at least partly intercalated in some fashion in a vesicle wall, as opposed to being encapsulated. In yet another embodiment of the invention where the first excipient substance forms liposomes, the exogenous chemical and/or second excipient substance is not encapsulated in or associated with the liposomes at all. Although the present invention does not exclude the possibility of so encapsulating or associating the exogenous chemical, a presently preferred dilute sprayable liposomal composition encapsulates less than 5% by weight of the exogenous chemical that is present in the overall composition. Another dilute sprayable liposomal embodiment of the present invention has no substantial amount (i.e., less than 1% by weight) of the exogenous chemical encapsulated in the liposomes. As a droplet of such a liposomal composition dries on foliage of a plant, the proportion of the exogenous chemical that is encapsulated in the liposomes may change. Compositions of the present invention that

include an exogenous chemical can be applied to foliage of plants in an amount that is effective to achieve the desired biological effect of the exogenous chemical. For example, when the exogenous chemical is a post-emergence herbicide, the composition can be applied to a plant in a herbicidally effective amount.

Without being bound by theory, it is believed that that the method and compositions of the present invention create or enlarge hydrophilic channels through the epicuticular wax of the plant cuticle, these channels being capable of accommodating the mass transfer of a water-soluble exogenous chemical into the plant, and thus transporting the exogenous chemical into the plant more rapidly or more completely than an epicuticular wax layer lacking such formation or enlargement of hydrophilic channels. Of course, certain compositions of the present invention can also enter a plant through stomata, but this generally requires a very low surface tension which is not an essential feature of the present compositions. The enhanced cuticular penetration believed to be achieved by the compositions of the present invention enhances the overall delivery and effectiveness of the exogenous chemical. Whereas an exogenous chemical such as glyphosate, formulated as an aqueous solution or dispersion with surfactants which do not have the property of forming anisotropic aggregates in or on a wax layer, normally penetrates through the epicuticular wax very slowly (e.g., in 1-4 days), a substantial portion of the exogenous chemical in compositions of the present invention penetrates much more quickly (e.g., in from about 10 minutes to a few hours, preferably in less than about 30 minutes).

Thus, methods and compositions of the invention are believed to owe their superior effectiveness at least in part to accelerated uptake into plant foliage. In conventional methods of treating plants with exogenous chemicals, in particular polar exogenous chemicals, the epicuticular wax layer presents an almost continuous barrier through which such exogenous chemicals diffuse with difficulty, even in the presence of surfactants which increase diffusive mobility but do not introduce the possibility of rapid mass transfer through hydrophilic channels.

Again without being bound by theory, it is believed that the hydrophilic channels are created within the epicuticular wax layer by the self-assembly of molecules of the first excipient substance which has a hydrophobic moiety that associates with the wax and a hydrophilic moiety that attracts water to form an aqueous continuum across the epicuticular wax layer linking up with hydrophilic pathways in the cuticle proper. A polar exogenous chemical can move by mass transfer along such an aqueous continuum to enter the plant.

Again without being bound by theory, it is believed that when the composition is present on the leaf of a plant as a droplet of aqueous solution or dispersion, in an aqueous microdomain on the cuticular surface (i.e., the aqueous region at the interface between the water droplet and the epicuticular wax), the majority (i.e., more than 50% by weight) of the aggregate-forming substance is present in a form other than a monolayer, for example as a bilayer or multilamellar (liquid crystal) structure. The aggregate-forming substances employed have several preferred characteristics that are believed to contribute to the

formation of transcuticular hydrophilic channels. For instance, they have a tendency to form extended self-assembled structures in the presence of water and the kinds of waxes encountered in cuticles. Generally, materials that form non-simple (i.e., not small spherical micellar structures) aggregates in solution, such as vesicles or cylindrical, discotic, or ribbon-like micellar structures are preferred. These tend to form more complex adsorbed and absorbed layers with hydrophobic substrates than those simple micellar systems that tend to produce simple adsorbed monolayers. These substances also tend to produce lyotropic mesophases such as lamellar, hexagonal or reversed hexagonal phases in the compositions established in the aqueous microdomains in or on the cuticle.

In one embodiment of the invention, a cationic headgroup on the first excipient substance is also preferred. The cationic group is believed to enhance initial adhesion to the leaf surface, since the majority of such surfaces carry an overall negative charge. The cationic group is also believed to contribute to the hydrophilicity of channels in the epicuticular wax formed or enlarged by the method and compositions of the invention. Cationic groups, in particular amine or ammonium groups, attract water molecules which further enlarge the hydrophilic channels and thereby provide an improved pathway of entry for exogenous chemicals that are polar or water-soluble.

It is further believed that the creation or enlargement of hydrophilic channels in epicuticular wax results in the wax becoming plasticized. A further embodiment of the invention is thus a method for applying an exogenous chemical to a plant having an epicuticular wax layer, comprising (a) plasticizing the epicuticular wax layer in conjunction with (b) contacting the epicuticular wax layer with the exogenous chemical. In this embodiment the step of plasticizing the epicuticular wax layer is accomplished by contacting the layer with an aqueous composition comprising a first excipient substance as defined above and optionally a second excipient substance as defined above. The weight ratio of the first excipient substance to the exogenous chemical is between about 1:3 and about 1:100.

Herbicidal compositions in accordance with the present invention are also useful in methods for enhancing the yield of a field crop. Such a method can comprise the steps of (a) planting a crop in a field, (b) substantially freeing the field of one or more weed species that would diminish the yield of the crop by applying to the weed species a herbicidally effective amount of a composition as described above, (c) allowing the crop to mature, and (d) harvesting the crop. Alternatively, the method can comprise the steps of (a) substantially freeing the field of one or more weed species that would diminish the yield of the crop by applying to the weed species a herbicidally effective amount of the composition, (b) planting the crop in the field, (c) allowing the crop to mature, and (d) harvesting the crop.

In one particular method in accordance with the present invention, a herbicidal composition as described above can be applied to a complex of weeds that are present in a single field, the weeds being, for example, velvetleaf, morningglory, and prickly sida. The composition is applied in a herbicidally effective amount, and provides herbicidal control of each of the weed species in the complex.

Another embodiment of the present invention is a herbicidal method, comprising contacting the foliage of a plant with a herbicidally effective amount of a composition as described above, whereby the herbicidal effectiveness of the composition on the plant to which it is applied is visibly better than the herbicidal effectiveness on that same species of plant, under substantially the same conditions, of a composition containing a similar amount of surfactant but that does not form anisotropic aggregates. "Visibly better" in this context means that the difference in herbicidal effect of the two compositions on the plants is readily noticeable to the eye of an experienced weed scientist.

Another embodiment of the present invention is a herbicidal method which can be used in a field that contains both weed and crop plants, where the crop plants are resistant to the effects of a particular herbicide at the rate that herbicide is used. The method comprises contacting the foliage of both the weeds and the crops in the field with a composition as described above. The composition will have a herbicidal effect on the weeds (i.e., it will partially or entirely kill the weeds) but it will not harm the crops. This herbicidal method applies to any combination of a selective post-emergence herbicide (e.g. 2,4-D) and a crop on which that herbicide can be used selectively to kill weeds (e.g., in the case of 2,4-D, wheat). This herbicidal method also applies to any combination of a normally non-selective post-emergence herbicide and a crop bred or genetically modified to be resistant to that herbicide. An example of a suitable combination of herbicide and herbicide-resistant crop is ROUNDUP® herbicide and ROUNDUP READY® crops, developed by Monsanto Company.

The compositions and methods of the present invention have a number of advantages. They provide enhanced biological activity of exogenous chemicals in or on plants in comparison with prior formulations, either in terms of greater ultimate biological effect, or obtaining an equivalent biological effect while using a reduced application rate of exogenous chemical. Certain herbicide formulations of the present invention can avoid antagonism that has been observed in some prior art herbicide formulations, and can minimize quick production of necrotic lesions on leaves that in some situations hinder overall translocation of herbicide in the plant. Certain herbicide compositions of the invention modify the spectrum of activity of the herbicide across a range of plant species. For example, certain formulations of the present invention containing glyphosate can provide good herbicidal activity against broadleaf weeds while not losing any herbicidal effectiveness on narrowleaf weeds. Others can enhance herbicidal effectiveness on narrowleaf weeds to a greater extent than on broadleaf weeds. Still others can have enhanced effectiveness which is specific to a narrow range of species or even a single species.

Another advantage of the present invention is that it employs relatively small amounts of the first and second excipient substances in relation to the amount of exogenous chemical employed. This makes the compositions and methods of the present invention relatively inexpensive, and also tends to reduce instability problems in specific compositions where one or both excipient substances are physically incompatible with the exogenous chemical (e.g., alkylether surfactants in solutions of high ionic strength, such as concentrated glyphosate salt solutions).

Even at the low concentrations of the excipient substances used in the present invention, there may be limits on the maximum concentration of exogenous chemical that can be used without causing compatibility problems (e.g., separation of the composition into discrete layers). In some preferred embodiments of the invention, composition stability at high loadings of exogenous chemical is maintained by adding other ingredients such as, for example, colloidal particulates. Some compositions of the present invention exhibit enhanced biological activity and have a higher loading of exogenous chemical than possible in prior art compositions.

Further, compositions of the present invention are less sensitive in some instances to environmental conditions such as relative humidity at the time of application to the plant. Also, the present invention allows the use of smaller amounts of herbicides or other pesticides, while still obtaining the required degree of control of weeds or other undesired organisms.

DESCRIPTION OF SPECIFIC EMBODIMENTS

When the phrase "anisotropic aggregates in or on a wax layer" is used herein, it relates to determinations made by the following test procedure. We have found this test to predict with a high degree of reliability whether a composition comprising water and an exogenous chemical, or a composition comprising water which is to be used in conjunction with an exogenous chemical, will show enhanced biological effectiveness when applied to foliage of plants. Modifications can be made to the test; however a procedure modified in some major respect will not necessarily give the same results and will not necessarily predict enhanced effectiveness as reliably as the procedure described here.

The first stage in the procedure is to prepare a wax-coated slide. We have found a preferred wax for the purpose to be a blend of carnauba wax and beeswax in a weight/weight ratio of approximately 10:1. A clear wax mixture is prepared consisting of 5% carnauba wax and 0.5% beeswax in isopropanol, and is maintained at a temperature of approximately 82°C. The end of a glass 2.4 cm x 7.2 cm microscope slide is immersed perpendicularly in the wax mixture to a depth of approximately one-third of the length of the slide. After 10 to 15 seconds, the slide is very slowly and steadily withdrawn from the wax mixture and allowed to cool, leaving a wax layer deposited on both faces of the slide.

Visual examination of the slide can give a preliminary indication of the thickness and uniformity of the wax coating. If imperfections are evident the slide is rejected. If the slide shows no obvious imperfections, the wax coating is carefully removed from one face of the slide by wiping with acetone. Further evaluation of the acceptability of the wax-coated slide for the test is done by examining the slide under a microscope. The slide is selected for use in the test if, on microscopic examination using a 4.9X objective, the wax coating is uniformly thick and there is uniform density of wax particles across the slide. Preference is for a coating that has few observable wax particles and exhibits a very dark field when examined under polarized light.

The next stage in the procedure is to conduct the test. For this purpose, samples of an exogenous chemical composition to be tested are diluted, if necessary, to 15% to 20% by weight of the exogenous

chemical. In the case of glyphosate, the desired concentration in a composition sample is 15% to 20% acid equivalent (a.e.). Samples of reference compositions are also prepared; in the case of glyphosate, Formulations B and J as defined in the Examples herein are appropriate.

For a composition of a first excipient substance not containing an exogenous chemical but to be applied in conjunction with an exogenous chemical, the desired concentration is approximately 5% to 7% by weight of the first excipient substance.

The following instrumentation, or equivalent, items are required or useful:

Nikon SMZ-10A stereoscopic microscope equipped for polarized light observation, photomicrography, and video observation and recording.

3CCD MTI camera.

Diagnostic Instruments 150 IL-PS power supply.

Sony Trinitron color video monitor, model PVM-1353MD.

Mitsubishi time-lapse video cassette recorder, model HS-S5600.

Hewlett Packard Pavillion 7270 computer, with Windows 95 and Image-Pro Plus version 2.0 electronic imaging program installed.

Hewlett Packard Deskjet 870Cse printer.

A wax-coated slide, prepared and selected as described above, is positioned on the microscope stage, with the system set to provide transmitted light, both straight and polarized. A 1 μl drop of the sample to be tested is applied to the wax surface using a thoroughly cleaned 1 μl Hamilton syringe. This and subsequent operations are followed through the microscope at 4.9X objective. Duplicate or triplicate tests are done for each composition. Numerous tests can be conducted simultaneously on a single slide. Progression of change in the microscopic appearance of the sample is observed through the microscope and recorded at designated time intervals. We have found useful intervals to be 1 minute, 10 minutes, 2 hours and >24 hours after application of the drop to the wax surface. Observations can also be made at intermediate times to capture possible significant transitions occurring at such times.

The temperature of the wax layer tends to increase with prolonged exposure to the microscope light. In many cases we have found this does not significantly interfere with the results obtained. However, in some cases temperature does affect the outcome of the test and in such cases it is preferred to illuminate the sample only for the short periods necessary to make observations, so that the temperature of the wax layer remains close to ambient temperature. An example of a composition of the invention where it is believed to be important to keep temperature close to ambient is one containing a fatty acid ester such as butyl stearate.

At dark field (polarized light) the wax layer is observed for birefringence, and at light field the character of the drop surface is observed, at each time interval. The following records are made:

birefringence (yes/no);

time of initial appearance of birefringence;

character of the birefringence;
appearance of drop surface as composition "dries";
degree of spread of the drop;
effects of temperature (warming of the slide) if any;
other noticeable changes.

Optionally, images are recorded at significant times using the 3CCD MTI camera and the Image-Pro Plus program as documentation of observed changes. Tests may if desired also be recorded on video, especially during the first 15 minutes. In addition to images captured using 4.9X objective, overall-field views using 0.75X objective can be recorded to provide clear comparisons of different samples tested on the same slide.

A particularly useful parameter for predicting enhanced effectiveness is the observation of birefringence (yes/no) 5-20 minutes after deposition of the test drop on the wax-coated slide. We have found 10-15 minutes after deposition to be an especially suitable time for observation of this parameter. The following results for oil-in-water emulsion compositions comprising glyphosate IPA salt, butyl stearate and alkylether surfactants are typical of those obtained. Each of compositions WCS-1 to WCS-5 contained 15% w/w glyphosate a.e., 0.5% w/w butyl stearate and 5% w/w alkylether surfactant. Formulations B and J are commercial standard compositions of glyphosate defined in the Examples section later herein, and were diluted to 15% glyphosate a.e. for the test.

Composition	Alkylether	Birefringence at 10 min.
WCS-1	Brij 78 (steareth-20)	yes
WCS-2	Plurafac A-38 (ceteareth-27)	yes
WCS-3	Brij 98 (oleth-20)	yes
WCS-4	Brij 35 (laureth-23)	no
WCS-5	Neodol 1-9 (C_{11} linear alcohol 9EO)	no
Formulation B		no
Formulation J		no

It will be noted that where the hydrophobic moiety of the alkylether was a C_{11} (WCS-5) or C_{12} (WCS-4) hydrocarbyl group, the composition did not show anisotropic properties in the form of birefringence 10 minutes after application to the wax-coated slide. However, where the hydrophobic moiety had a carbon chain length of 16 to 18 (WCS-1 to WCS-3), birefringence was evident, indicating the presence of anisotropic aggregates in or on the wax layer. The intensity of birefringence was greatest with WCS-1 (containing steareth-20), followed by WCS-2 (containing ceteareth-27) and then WCS-3 (oleth-20).

Tests of alkylether compositions, as evidenced in Examples herein, have shown that in general those containing alkylethers of hydrophobe carbon chain length 16 or greater show greater biological effectiveness than those having a shorter hydrophobe. In general greater biological effectiveness has

been obtained where the hydrophobe is saturated (as, for example, in steareth-20 and ceteareth-27) than where it is unsaturated (as, for example, in oleth-20).

The following compositions were made containing 15% glyphosate a.e. and 5% alkylether surfactant, but no butyl stearate. In WCS-10 the surfactant was steareth-10, in WCS-11 oleth-10 and in WCS-12 steareth-8 (laboratory sample from Sigma).

Composition	Alkylether	Birefringence at 15 min.
WCS-10	Brij 76 (steareth-10)	yes
WCS-11	Brij 97 (oleth-10)	no
WCS-12	steareth-8	yes

The property of forming anisotropic aggregates as determined by this test appears to require, on a C_{16-18} straight-chain alcohol, a minimum of about 10 moles of ethylene oxide (EO). Where the alcohol is oleyl, an EO chain of 10 units is already too short, but where the alcohol is stearyl, even as short an EO chain as 8 units appears to suffice. It should be noted, however, that the steareth-8 used in composition WCS-12 was obtained as a laboratory sample and is likely chemically purer than the commercial surfactants used in other compositions. Commercial grade steareth-8 will not necessarily give the same result.

As further evidence of the usefulness of the present anisotropy test in predicting biological effectiveness of exogenous chemical compositions, compositions WCS-6, WCS-7 and WCS-8 were prepared, each containing 30% glyphosate a.e. by weight, and were then diluted to 15% glyphosate a.e. for the test. All contained soybean lecithin (45% phospholipid, Avanti) and were prepared by process (v) as detailed in the Examples herein. Composition WCS-6, before dilution, contained 5% lecithin, 5% Fluorad FC-754 and 0.75% Ethomeen T/25. Composition WCS-7, before dilution, contained 2% lecithin and 2% Fluorad FC-754. Composition WCS-8, before dilution, contained 2% lecithin and 0.75% Ethomeen T/25. In addition, Composition WCS-9 was prepared containing 15% glyphosate a.e. and 5% soybean lecithin (45% phospholipid, Avanti). The following results were obtained.

Composition	Excipient ingredients	Birefringence at 10 min.
WCS-6	lecithin + FC-754 + Ethomeen T/25	yes
WCS-7	lecithin + FC-754	yes
WCS-8	lecithin + Ethomeen T/25	no
WCS-9	lecithin	no

As evidenced in the Examples herein, enhanced biological effectiveness is a feature of compositions containing lecithin as the first excipient substance and Fluorad FC-754 as the second excipient substance. In the absence of Fluorad FC-754 or like material, lecithin, either alone or together with a tertiary alkylamine surfactant such as Ethomeen T/25 or MON 0818, does not consistently generate the desired enhancement.

In a further demonstration of the usefulness of the present anisotropy test, compositions WCS-13 and WCS-14 were prepared, each containing 20% glyphosate a.e. by weight, and were then diluted to 15% glyphosate a.e. for the test. Both contained soybean lecithin (45% phospholipid, Avanti). Composition WCS-13 was made by process (x) as described in the Examples herein and, before dilution, contained 6% lecithin, 6% Ethomeen T/25 and 1.5% butyl stearate. Composition WCS-14 was identical except that it contained no butyl stearate. Particular care was taken in this study to avoid excessive warming of the wax-coated slide by prolonged illumination. The following results were obtained.

Composition	Excipient ingredients	Birefringence at 15 min.
WCS-13	lecithin + Ethomeen T/25 + butyl stearate	yes
WCS-14	lecithin + Ethomeen T/25	no

The addition of a small quantity of butyl stearate was thus sufficient to confer, on a glyphosate + lecithin + Ethomeen T/25 composition, the property of forming anisotropic aggregates in or on a wax layer. The Examples herein illustrate the unexpected enhancement of biological effectiveness observed when an exogenous chemical is formulated with lecithin and a fatty acid ester such as butyl stearate.

Thus where, for reasons of economy, compatibility with the exogenous chemical, or other considerations it is desired to provide an exogenous chemical composition having a relatively low content of excipient substances (for example a weight ratio of each excipient substance to exogenous chemical of about 1:3 or less), the anisotropy test provided here is an in vitro assay method which can be used to identify biologically effective compositions in advance of extensive testing in vivo.

The in vitro assay method just described, together with modifications thereof that will be readily apparent to those of skill in the art, is a further embodiment of the present invention.

Examples of exogenous chemical substances that can be included in compositions of the present invention include, but are not limited to, chemical pesticides (such as herbicides, algicides, fungicides, bactericides, viricides, insecticides, aphicides, miticides, nematicides, molluscicides and the like), plant growth regulators, fertilizers and nutrients, gametocides, defoliants, desiccants, mixtures thereof and the like. In one embodiment of the invention, the exogenous chemical is polar.

A preferred group of exogenous chemicals are those that are normally applied post-emergence to the foliage of plants, i.e. foliar-applied exogenous chemicals.

Some exogenous chemicals useful in the present invention are water-soluble, for example salts that comprise biologically active ions, and also comprise counterions, which may be biologically inert or relatively inactive. A particularly preferred group of these water-soluble exogenous chemicals or their biologically active ions or moieties are systemic in plants, that is, they are to some extent translocated from the point of entry in the foliage to other parts of the plant where they can exert their desired biological effect. Especially preferred among these are herbicides, plant growth regulators and nematicides, particularly those that have a molecular weight, excluding counterions, of less than about

300. More especially preferred among these are exogenous chemical compounds having one or more functional groups selected from amine, carboxylate, phosphonate and phosphinate groups.

Among such compounds, an even more preferred group are herbicidal or plant growth regulating exogenous chemical compounds having at least one of each of amine, carboxylate, and either phosphonate or phosphinate functional groups. Salts of N-phosphonomethylglycine are examples of this group of exogenous chemicals. Further examples include salts of glufosinate, for instance the ammonium salt (ammonium DL-homoalanin-4-yl (methyl) phosphinate).

Another preferred group of exogenous chemicals which can be applied by the method of the invention are nematicides such as those disclosed in U.S. Patent No. 5,389,680, the disclosure of which is incorporated herein by reference. Preferred nematicides of this group are salts of 3,4,4-trifluoro-3-butenoic acid or of N-(3,4,4-trifluoro-1-oxo-3-butenyl)glycine.

Exogenous chemicals which can usefully be applied by the method of the present invention are normally, but not exclusively, those which are expected to have a beneficial effect on the overall growth or yield of desired plants such as crops, or a deleterious or lethal effect on the growth of undesirable plants such as weeds. The method of the present invention is particularly useful for herbicides, especially those that are normally applied post-emergence to the foliage of unwanted vegetation.

Herbicides which can be applied by the method of the present invention include but are not limited to any listed in standard reference works such as the "Herbicide Handbook," Weed Science Society of America, 1994, 7th Edition, or the "Farm Chemicals Handbook," Meister Publishing Company, 1997 Edition. Illustratively these herbicides include acetanilides such as acetochlor, alachlor and metolachlor, aminotriazole, asulam, bentazon, bialaphos, bipyridyls such as paraquat, bromacil, cyclohexenones such as clethodim and sethoxydim, dicamba, diflufenican, dinitroanilines such as pendimethalin, diphenylethers such as acifluorfen, fomesafen and oxyfluorfen, fatty acids such as C_{9-10} fatty acids, fosamine, flupoxam, glufosinate, glyphosate, hydroxybenzonitriles such as bromoxynil, imidazolinones such as imazaquin and imazethapyr, isoxaben, norflurazon, phenoxies such as 2,4-D, phenoxypropionates such as diclofop, fluazifop and quizalofop, picloram, propanil, substituted ureas such as fluometuron and isoproturon, sulfonylureas such as chlorimuron, chlorsulfuron, halosulfuron, metsulfuron, primisulfuron, sulfometuron and sulfosulfuron, thiocarbamates such as triallate, triazines such as atrazine and metribuzin, and triclopyr. Herbicidally active derivatives of any known herbicide are also within the scope of the present invention. A herbicidally active derivative is any compound which is a minor structural modification, most commonly but not restrictively a salt or ester, of a known herbicide. These compounds retain the essential activity of the parent herbicide, but may not necessarily have a potency equal to that of the parent herbicide. These compounds may convert to the parent herbicide before or after they enter the treated plant. Mixtures or coformulations of a herbicide with other ingredients, or of more than one herbicide, may likewise be employed.

An especially preferred herbicide is N-phosphonomethylglycine (glyphosate), a salt, adduct or ester thereof, or a compound which is converted to glyphosate in plant tissues or which otherwise provides glyphosate ion. Glyphosate salts that can be used according to this invention include but are not restricted to alkali metal, for example sodium and potassium, salts; ammonium salt; alkylamine, for example dimethylamine and isopropylamine, salts; alkanolamine, for example ethanolamine, salts; alkylsulfonium, for example trimethylsulfonium, salts; sulfoxonium salts; and mixtures thereof. The herbicidal compositions sold by Monsanto Company as ROUNDUP® and ACCORD® contain the monoisopropylamine (IPA) salt of N-phosphonomethylglycine. The herbicidal compositions sold by Monsanto Company as ROUNDUP® Dry and RIVAL® contain the monoammonium salt of N-phosphonomethylglycine. The herbicidal composition sold by Monsanto Company as ROUNDUP® Geoforce contains the monosodium salt of N-phosphonomethylglycine. The herbicidal composition sold by Zeneca as TOUCHDOWN® contains the trimethylsulfonium salt of N-phosphonomethylglycine. The herbicidal properties of N-phosphonomethylglycine and its derivatives were first discovered by Franz, then disclosed and patented in U.S. Patent 3,799,758, issued March 26, 1974. A number of herbicidal salts of N-phosphonomethylglycine were patented by Franz in U.S. Patent 4,405,531, issued September 20, 1983. The disclosures of both of these patents are hereby incorporated by reference.

Because the commercially most important herbicidal derivatives of N-phosphonomethylglycine are certain salts thereof, the glyphosate compositions useful in the present invention will be described in more detail with respect to such salts. These salts are well known and include ammonium, IPA, alkali metal (such as the mono-, di-, and trisodium salts, and the mono-, di-, and tripotassium salts), and trimethylsulfonium salts. Salts of N-phosphonomethylglycine are commercially significant in part because they are water soluble. The salts listed immediately above are highly water soluble, thereby allowing for highly concentrated solutions that can be diluted at the site of use. In accordance with the method of this invention as it pertains to glyphosate herbicide, an aqueous solution containing a herbicidally effective amount of glyphosate and other components in accordance with the invention is applied to foliage of plants. Such an aqueous solution can be obtained by dilution of a concentrated glyphosate salt solution with water, or dissolution or dispersion in water of a dry (e.g. granular, powder, tablet or briquette) glyphosate formulation.

Exogenous chemicals should be applied to plants at a rate sufficient to give the desired biological effect. These application rates are usually expressed as amount of exogenous chemical per unit area treated, e.g. grams per hectare (g/ha). What constitutes a "desired effect" varies according to the standards and practice of those who investigate, develop, market and use a specific class of exogenous chemicals. For example, in the case of a herbicide, the amount applied per unit area to give 85% control of a plant species as measured by growth reduction or mortality is often used to define a commercially effective rate.

Herbicidal effectiveness is one of the biological effects that can be enhanced through this invention. "Herbicidal effectiveness," as used herein, refers to any observable measure of control of plant growth, which can include one or more of the actions of (1) killing, (2) inhibiting growth, reproduction or proliferation, and (3) removing, destroying, or otherwise diminishing the occurrence and activity of plants.

The herbicidal effectiveness data set forth herein report "inhibition" as a percentage following a standard procedure in the art which reflects a visual assessment of plant mortality and growth reduction by comparison with untreated plants, made by technicians specially trained to make and record such observations. In all cases, a single technician makes all assessments of percent inhibition within any one experiment or trial. Such measurements are relied upon and regularly reported by Monsanto Company in the course of its herbicide business.

The selection of application rates that are biologically effective for a specific exogenous chemical is within the skill of the ordinary agricultural scientist. Those of skill in the art will likewise recognize that individual plant conditions, weather and growing conditions, as well as the specific exogenous chemical and formulation thereof selected, will affect the efficacy achieved in practicing this invention. Useful application rates for exogenous chemicals employed can depend upon all of the above conditions. With respect to the use of the method of this invention for glyphosate herbicide, much information is known about appropriate application rates. Over two decades of glyphosate use and published studies relating to such use have provided abundant information from which a weed control practitioner can select glyphosate application rates that are herbicidally effective on particular species at particular growth stages in particular environmental conditions.

Herbicidal compositions of glyphosate or derivatives thereof are used to control a very wide variety of plants worldwide. Such compositions can be applied to a plant in a herbicidally effective amount, and can effectively control one or more plant species of one or more of the following genera without restriction: Abutilon, Amaranthus, Artemisia, Asclepias, Avena, Axonopus, Borreria, Brachiaria, Brassica, Bromus, Chenopodium, Cirsium, Commelina, Convolvulus, Cynodon, Cyperus, Digitaria, Echinochloa, Eleusine, Elymus, Equisetum, Erodium, Helianthus, Imperata, Ipomoea, Kochia, Lolium, Malva, Oryza, Ottochloa, Panicum, Paspalum, Phalaris, Phragmites, Polygonum, Portulaca, Pteridium, Pueraria, Rubus, Salsola, Setaria, Sida, Sinapis, Sorghum, Triticum, Typha, Ulex, Xanthium, and Zea.

Particularly important species for which glyphosate compositions are used are exemplified without limitation by the following:

Annual broadleaves:

velvetleaf (Abutilon theophrasti)

pigweed (Amaranthus spp.)

buttonweed (Borreria spp.)

oilseed rape, canola, indian mustard, etc. (Brassica spp.)

commelina (Commelina spp.)
filaree (Erodium spp.)
sunflower (Helianthus spp.)
morningglory (Ipomoea spp.)
kochia (Kochia scoparia)
mallow (Malva spp.)
wild buckwheat, smartweed, etc. (Polygonum spp.)
purslane (Portulaca spp.)
russian thistle (Salsola spp.)
sida (Sida spp.)
wild mustard (Sinapis arvensis)
cocklebur (Xanthium spp.)

Annual narrowleaves:
wild oat (Avena fatua)
carpetgrass (Axonopus spp.)
downy brome (Bromus tectorum)
crabgrass (Digitaria spp.)
barnyardgrass (Echinochloa crus-galli)
goosegrass (Eleusine indica)
annual ryegrass (Lolium multiflorum)
rice (Oryza sativa)
ottochloa (Ottochloa nodosa)
bahiagrass (Paspalum notatum)
canarygrass (Phalaris spp.)
foxtail (Setaria spp.)
wheat (Triticum aestivum)
corn (Zea mays)

Perennial broadleaves:
mugwort (Artemisia spp.)
milkweed (Asclepias spp.)
canada thistle (Cirsium arvense)
field bindweed (Convolvulus arvensis)
kudzu (Pueraria spp.)

Perennial narrowleaves:
brachiaria (Brachiaria spp.)
bermudagrass (Cynodon dactylon)
yellow nutsedge (Cyperus esculentus)
purple nutsedge (C. rotundus)
quackgrass (Elymus repens)
lalang (Imperata cylindrica)
perennial ryegrass (Lolium perenne)
guineagrass (Panicum maximum)
dallisgrass (Paspalum dilatatum)
reed (Phragmites spp.)
johnsongrass (Sorghum halepense)
cattail (Typha spp.)

Other perennials:
horsetail (Equisetum spp.)
bracken (Pteridium aquilinum)
blackberry (Rubus spp.)
gorse (Ulex europaeus)

Thus, the method of the present invention, as it pertains to glyphosate herbicide, can be useful on any of the above species.

Effectiveness in greenhouse tests, usually at exogenous chemical rates lower than those normally effective in the field, is a proven indicator of consistency of field performance at normal use rates. However, even the most promising composition sometimes fails to exhibit enhanced performance in individual greenhouse tests. As illustrated in the Examples herein, a pattern of enhancement emerges over a series of greenhouse tests; when such a pattern is identified this is strong evidence of biological enhancement that will be useful in the field.

Aggregate-forming substances useful as the first excipient substance in compositions of the present invention include a wide variety of amphiphilic materials, of which three classes are preferred.

The first preferred class of aggregate-forming substances can be defined as amphiphilic liposome-forming substances. These include various lipids of synthetic, animal, or plant origin, including phospholipids, ceramides, sphingolipids, dialkyl surfactants, and polymeric surfactants. A variety of these materials are known to those skilled in the art, and are commercially available. Lecithins are particularly rich in phospholipids and can be derived from a number of plant and animal sources.

Soybean lecithin is one particular example of a relatively inexpensive commercially available material that includes such substances.

Many other substances have been described which can be used to form liposomes; the present invention includes compositions comprising any such liposome-forming substances, so long as other requirements set out above are met, and use of such compositions for enhancing biological effectiveness of exogenous chemicals applied to foliage of plants. For example, US Patent No. 5,580,859, incorporated here by reference, discloses liposome-forming substances having a cationic group, including N-(2,3-di-(9-(Z)-octadecenyloxy))-prop-1-yl-N,N,N-trimethylammonium chloride (DOTMA) and 1,2-bis(oleoyloxy)-3-(trimethylammonio)propane (DOTAP). Liposome-forming substances which are not themselves cationic, but do contain a cationic group as part of the hydrophilic moiety, include for example dioleoylphosphatidylcholine (DOPC) and dioleoylphosphatidylethanolamine (DOPE). Liposome-forming substances that do not contain a cationic group include dioleoylphosphatidylglycerol (DOPG). Any of these liposome-forming substances can be used with or without the addition of cholesterol.

These substances contain portions that are hydrophilic and hydrophobic within the same molecule. They have the ability to self-assemble in aqueous solution or dispersion into structures that are more complex than simple micelles. The nature of the aggregate that will be formed can be related to the critical packing parameter P by the following equation:

$$P = V / lA$$

where V is the volume of the hydrophobic tail of the molecule, l is the effective length of the hydrophobic tail, and A is the area occupied by the hydrophilic headgroup in the surface of the aggregate. The most probable self-assembled structures are spherical micelles when P is less than 1/3, rodlike micelles when P is between 1/3 and ½, lamellar when P is between 1 and ½, and inverse structures when P is greater than 1. The preferred materials in the present invention have P greater than 1/3.

Cationic liposome-forming substances having a hydrophobic moiety comprising two hydrocarbyl chains are accompanied by a counterion (anion), identified as Z in formulas I, II and III above. Any suitable anion can be used, including agriculturally acceptable anions such as hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate. In a specific embodiment where the exogenous chemical has a biologically active anion, that anion can serve as the counterion for the liposome-forming substance. For example, glyphosate can be used in its acid form together with the hydroxide of a cationic liposome-forming substance such as a compound of formula I.

Compounds of formula I known in the art to be liposome-forming include distearyldimethylammonium chloride and bromide (also known in the art as DODAC and DODAB respectively). Compounds of formula II known in the art to be liposome-forming include DOTMA referenced above and dimyristooxypropyldimethylhydroxyethylammonium bromide (DMRIE). Compounds of formula III known in the art to be liposome-forming include dioleoyloxy-3-

(dimethylammonio)propane (DODAP) and DOTAP referenced above. Compounds of formula IV known in the art to be liposome-forming include DOPC and DOPE, both referenced above.

In many liposome-forming substances known in the art, the hydrophobic hydrocarbyl chains are unsaturated, having one or more double bonds. Particularly commonly used in the pharmaceutical art are dioleyl or dioleoyl compounds. A potential problem with these is that in an oxidizing environment they become oxidized at the site of the double bond. This can be inhibited by including in the formulation an antioxidant such as ascorbic acid. Alternatively the problem can be avoided by use of liposome-forming substances wherein a high proportion of the hydrophobic hydrocarbyl chains are fully saturated. Thus in a preferred embodiment of the invention, R^1 and R^2 in formulas I-IV are independently saturated straight-chain alkyl groups. Particularly preferred compositions use liposome-forming substances in which R^1 and R^2 are both palmityl (cetyl) or palmitoyl or, alternatively, are both stearyl or stearoyl groups.

Phospholipids, because of their low cost and favorable environmental properties, are particularly favored among liposome-forming substances in the method and compositions of the invention. Vegetable lecithins, such as soybean lecithin, have successfully been used in accordance with the invention. The phospholipid content of the lecithin product can range from about 10% to close to 100%. While acceptable results have been obtained with crude lecithin (10-20% phospholipid), it is generally preferred to use lecithin that is at least partially de-oiled, so that the phospholipid content is in the region of about 45% or more. Higher grades, such as 95%, provide excellent results but the much higher cost is unlikely to be justified for most applications.

The phospholipid component of lecithin, or any phospholipid composition used in the present invention, may comprise one or more phosphatides of natural or synthetic origin. Each of these phosphatides is generally a phosphoric ester that on hydrolysis yields phosphoric acid, fatty acid(s), polyhydric alcohol and, typically, a nitrogenous base. A phosphatide component may be present in a partially hydrolyzed form, *e.g.* as phosphatidic acid. Suitable phosphatides include, without limitation, phosphatidylcholine, hydrogenated phosphatidylcholine, phosphatidylinositol, phosphatidylserine, phosphatidic acid, phosphatidylglycerol, phosphatidylethanolamine, N-acyl phosphatidylethanolamine, and mixtures of any of these.

In vegetable lecithins a high proportion of the hydrophobic hydrocarbyl chains of the phospholipid compounds are typically unsaturated. One preferred embodiment of compositions in accordance with the present invention comprises both saturated phospholipid and unsaturated phospholipid, with the weight ratio of saturated phospholipid to unsaturated phospholipid being greater than about 1:2. In various particularly preferred embodiments, (1) at least 50% by weight of the phospholipids are di-C_{12-22}-saturated alkanoyl phospholipid, (2) at least 50% by weight of the phospholipids are di-C_{16-18}-saturated alkanoyl phospholipid, (3) at least 50% by weight of the phospholipids are distearoyl phospholipid, (4) at least 50% by weight of the phospholipids are

dipalmitoyl phospholipid, or (5) at least 50% by weight of the phospholipids are distearoyl phosphatidylcholine, dipalmitoyl phosphatidylcholine, or a mixture thereof. Higher proportions of saturated alkanoyl phospholipids are generally found in lecithins of animal origin, such as for example egg yolk lecithin, than in vegetable lecithins.

Phospholipids are known to be chemically unstable, at least in acid media, where they tend to degrade to their lyso-counterparts. Thus where phospholipids rather than more stable liposome-forming substances are used, it is usually preferable to adjust the pH of the composition upward. In the case of glyphosate compositions, the pH of a composition based on a mono-salt such as the monoisopropylammonium (IPA) salt is typically around 5 or lower. When phospholipids are used as the first excipient substance in a glyphosate composition of the invention, it will therefore be preferable to raise the pH of the composition, for example to around 7. Any convenient base can be used for this purpose; it will often be most convenient to use the same base as used in the glyphosate salt, for example isopropylamine in the case of glyphosate IPA salt.

Amphiphilic compounds useful as the first excipient substance herein are not limited to those having two hydrophobic hydrocarbyl groups such as the compounds of formulas I to IV. The second preferred class of aggregate-forming substances useful in the invention are cationic surfactant compounds having formula V above. In compounds of formula V, R^8 unless perfluorinated preferably has from about 12 to about 18 carbon atoms. R^8 is preferably perfluorinated, in which case it preferably has from about 6 to about 12 carbon atoms. Preferably n is 3. R^9 groups are preferably methyl.

Sulfonylamino compounds of formula V are especially preferred. Suitable examples include 3-(((heptadecafluorooctyl)sulfonyl)amino)-N,N,N-trimethyl-1-propaminium iodide, available for example as Fluorad FC-135 from 3M Company, and the corresponding chloride. It is believed that Fluorad FC-754 of 3M Company is the corresponding chloride.

Fluoro-organic surfactants such as the cationic types falling within formula V belong to a functional category of surfactants known in the art as "superspreaders" or "superwetters". As a class "superspreaders" or "superwetters" are very effective in reducing surface tension of aqueous compositions containing relatively low concentrations of these surfactants. In many applications fluoro-organic surfactants can substitute for organosilicone surfactants which are likewise "superspreaders" or "superwetters". An example is found in European patent application 0 394 211 which discloses that either organosilicone or fluoro-organic surfactants can be used interchangeably in solid granular formulations of pesticides to improve dissolution rate.

Two major problems have limited interest in "superspreaders" and "superwetters" by formulators of exogenous chemicals such as pesticides. The first is high unit cost. The second is that although surfactants of this functional category can enhance performance of an exogenous chemical on some species, for example by assisting penetration of the exogenous chemical into the interior of leaves

via stomata, they can be antagonistic, sometimes severely so, to performance of the same exogenous chemical on other species.

Surprisingly, a subclass of fluoro-organic surfactants has now been found to be essentially non-antagonistic at concentrations which nevertheless provide useful adjuvant effects. This subclass comprises cationic fluoro-organic surfactants of formula V and others having a property profile in common with those of formula V. The lack of antagonism makes this subclass very different from other fluoro-organic "superspreaders" or "superwetters". Further, it has been found that these non-antagonistic fluoro-organic surfactants can be useful at concentrations low enough to be cost-effective. Data in the Examples herein for compositions comprising Fluorad FC-135 or Fluorad FC-754 illustrate the unexpected properties of this subclass.

Derivatives of Fluorad FC-754, herein described as "FC-acetate" and "FC-salicylate," have been prepared by the following procedure. (1) The solvent in a sample of Fluorad FC-754 is gently evaporated off by heating in a glass beaker at 70-80°C, to leave a solid residue. (2) The solid residue is allowed to cool to room temperature. (3) A 1 g aliquot of the residue is placed in a centrifuge tube and dissolved in 5 ml isopropanol. (4) A saturated solution of potassium hydroxide (KOH) is prepared in isopropanol. (5) This solution is added drop by drop to the solution of FC-754 residue; this results in formation of a precipitate and addition of KOH solution continues until no further precipitate forms. (6) The tube is centrifuged at 4000 rpm for 5 minutes. (7) More KOH solution is added to check if precipitation is complete; if not, the tube is centrifuged again. (8) The supernatant is decanted into another glass tube. (9) A saturated solution of acetic acid (or salicylic acid) is prepared in isopropanol. (10) This solution is added to the supernatant in an amount sufficient to lower pH to 7. (11) Isopropanol is evaporated from this neutralized solution by heating at 60°C until completely dry. (12) The residue (either the acetate or salicylate salt) is dissolved in a suitable amount of water and is then ready for use.

The third preferred class of aggregate-forming substance useful as the first excipient substance according to the present invention is a long-chain alkylether surfactant having the formula VI above. R^{12} can be branched or unbranched, saturated or unsaturated. R^{12} is preferably straight chain saturated C_{16} alkyl (cetyl) or straight chain saturated C_{18} alkyl (stearyl). In preferred alkylethers m is 0, n is an average number from about 20 to about 40 and R^{13} is preferably hydrogen. Among especially preferred alkylether surfactants are those identified in the International Cosmetic Ingredient Directory as ceteth-20, ceteareth-20, ceteareth-27, steareth-20 and steareth-30.

Of the classes of aggregate-forming substance useful as the first excipient substance, not all give rise to anisotropic aggregates in or on a wax layer, as required by the present invention, when used as the sole excipient substance in the composition at a weight ratio of 1:3 to 1:100 with the exogenous chemical. Many compounds of formulas V and VI are sufficient in the absence of a second excipient substance, but in general the liposome-forming substances of formulas I to IV require the presence of a second excipient substance to exhibit the required anisotropic behavior. However, even in the presence

of a first excipient substance of formulas V or VI, there may be advantages in also including a second excipient substance as herein defined.

The second excipient substance has one or more hydrophobic moieties. If there is only one hydrophobic moiety, it is a hydrocarbyl or haloalkyl group having about 6 to about 22 carbon atoms. If there is more than one hydrophobic moiety, each such moiety is a hydrocarbyl or haloalkyl group having more than 2 carbon atoms, and the total number of carbon atoms in the hydrophobic moieties is about 12 to about 40.

One class of second excipient substance useful in the present invention is quaternary ammonium compounds. Among quaternary ammonium compounds that may be used are compounds of formula

$$N^+(R^{16})(R^{17})(R^{18})(R^{19})\ Q^- \qquad \text{VIII}$$

where R^{16}, R^{17}, R^{18} and R^{19} are independently C_{3-6} alkyl groups and Q is a suitable anion, such as for example hydroxide, chloride, bromide, iodide, sulfate, phosphate or acetate. In preferred compounds of formula VIII all R groups are the same. Particularly preferred compounds of formula VIII are tetrabutylammonium salts. Where the exogenous chemical comprises a biologically active anion, a salt of formula VIII where Q is that anion is an option providing both the exogenous chemical and second excipient substance. An example is the tetrabutylammonium salt of glyphosate.

Other quaternary ammonium compounds that may be useful include compounds having a single C_{12-22} hydrocarbyl group and three C_{1-4} alkyl groups attached to the quaternary nitrogen atom. One or more of the C_{1-4} alkyl groups in such compounds can be replaced by a benzyl group. Specific examples include cetyltrimethylammonium bromide and benzalkonium chloride. Yet other quaternary ammonium compounds useful as the second excipient substance include compounds of formula I, where the first excipient substance is not of formula I.

Preferred quaternary ammonium compounds useful as the second excipient substance are compounds of formula V, where the first excipient substance is not of formula V. The same specific compounds of formula V are especially preferred whether a compound of formula V is the first or the second excipient substance. Particularly good results have been obtained where the first excipient substance is lecithin and the second excipient substance is Fluorad FC-135 or FC-754 or chemical equivalents thereof.

Another class of compound useful as the second excipient substance is an amide or ester of formula VII above.

R^{14} in formula VII is preferably aliphatic and has about 7 to about 21 carbon atoms, more preferably about 13 to about 21 carbon atoms. It is especially preferred that R^{14} be a saturated straight-chain alkyl group. R^{15} is preferably an aliphatic group having 1-6 carbon atoms, more preferably alkyl or alkenyl having 2-4 carbon atoms. An especially preferred compound of formula VII for use as the second excipient substance is butyl stearate.

As compounds of formula VII, including butyl stearate, are generally oily liquids, aqueous compositions containing them are typically emulsions having at least one aqueous phase and at least one oil phase, with the compound of formula VII being present predominantly in the oil phase. Such emulsions may be water-in-oil, oil-in-water or water-in-oil-in-water (W/O/W) multiple emulsions.

Aqueous concentrate compositions where the first excipient substance is an alkylether of formula VI and the second excipient substance, if present, is a fatty acid ester of formula VII are limited in the degree to which an exogenous chemical such as glyphosate can be loaded. At some point, as the loading of exogenous chemical is increased, the composition will not remain suitably stable. Addition of a small amount of colloidal particulate to such compositions has surprisingly been found to greatly increase loading ability while retaining desired stability. Oxides of silicon, aluminum and titanium are preferred colloidal particulate materials. Particle size is preferably such that specific surface area is in the range from about 50 to about 400 m^2/g. Where the exogenous chemical is glyphosate, the use of colloidal particulate enables loadings of at least 30% by weight for compositions containing sufficient alkylether and fatty acid ester to show enhanced herbicidal effectiveness, or at least 40% for compositions containing alkylether but no fatty acid ester, and showing herbicidal effectiveness at least equal to current commercial products loaded at about 30%. We have found especially useful improvement in storage stability can be obtained using colloidal particulates having specific surface area between about 180 and about 400 m^2/g.

Other means of improving stability of highly loaded compositions comprising an alkylether of formula VI, with or without a fatty acid ester, may also be possible and are within the scope of the present invention.

Compositions in accordance with the present invention are typically prepared by combining water, the exogenous chemical (unless it is a formulation which will not contain an exogenous chemical) and the aggregate-forming substance. Where the aggregate-forming substance is one that disperses readily in water, as is the case for example with Fluorad FC-135 or Fluorad FC-754, simple mixing with mild agitation may be sufficient. However, where the aggregate-forming substance requires high shear to disperse in water, as is the case for example with most forms of lecithin, it is presently preferred to sonicate or microfluidize the aggregate-forming substance in water. This can be done before or after a surfactant and/or the exogenous chemical is added. The sonication or microfluidization will generally produce liposomes or other aggregate structures other than simple micelles. The precise nature, including average size, of liposomes or other aggregates depends among other things on the energy input during sonication or microfluidization. Higher energy input generally results in smaller liposomes. Although it is possible to entrap or otherwise bind loosely or tightly the exogenous chemical in or on liposomes or with other supramolecular aggregates, the exogenous chemical does not need to be so entrapped or bound, and in fact the present invention is effective when the exogenous chemical is not entrapped or bound in the aggregates at all.

In a particular embodiment of the invention, the liposomes or other aggregates have an average diameter of at least 20 nm, more preferably at least 30 nm. We have determined by light scattering that certain liposomal compositions of the invention have average liposome diameters ranging from 54 to 468 nm as calculated using linear fit and from 38 to 390 nm as calculated using quadratic fit.

The concentrations of the various components will vary, in part depending on whether a concentrate is being prepared that will be further diluted before spraying onto a plant, or whether a solution or dispersion is being prepared that can be sprayed without further dilution.

In an aqueous glyphosate formulation that includes a dialkyl surfactant, for example a cationic dialkyl surfactant of formula I, suitable concentration ranges are: glyphosate 0.1 - 400 grams acid equivalent (a.e.)/liter, and dialkyl surfactant 0.001 - 10% by weight. In an aqueous glyphosate formulation using a cationic fluoro-organic surfactant and lecithin, suitable concentrations can be: glyphosate 0.1 - 400 g a.e./l, fluoro-organic surfactant 0.001 - 10% by weight, and soybean lecithin 0.001 - 10% by weight.

In an aqueous glyphosate formulation that includes a C_{16-18} alkylether surfactant and butyl stearate, suitable concentrations can be: glyphosate 0.1 - 400 g a.e./l, alkylether surfactant 0.001 - 10% by weight, and butyl stearate 0.001 - 10% by weight. To achieve the higher concentrations in these ranges, it is often beneficial to add other ingredients to provide acceptable storage stability, for example colloidal particulate silica or aluminum oxide at 0.5 - 2.5% by weight. In an aqueous glyphosate formulation that includes a C_{16-18} alkylether surfactant but no butyl stearate, glyphosate concentration can suitably be increased to 500 g a.e./l or more, in the presence of a colloidal particulate at 0.5 - 2.5% by weight.

In solid glyphosate formulations, higher concentrations of ingredients are possible because of the elimination of most of the water.

Weight/weight ratios of ingredients may be more important than absolute concentrations. For example, in a glyphosate formulation containing lecithin and a cationic fluoro-organic surfactant, the ratio of lecithin to glyphosate a.e. is in the range from about 1:3 to about 1:100. It is generally preferred to use a ratio of lecithin to glyphosate a.e. close to as high as can be incorporated in the formulation while maintaining stability, in the presence of an amount of the fluoro-organic surfactant sufficient to give the desired enhancement of herbicidal effectiveness. For example, a lecithin/glyphosate a.e. ratio in the range from about 1:3 to about 1:10 will generally be found useful, although lower ratios, from about 1:10 to about 1:100 can have benefits on particular weed species in particular situations. The ratio of fluoro-organic surfactant, when present, to glyphosate a.e. is likewise preferably in the range from about 1:3 to about 1:100. Because fluoro-organic surfactants tend to have relatively high cost, it will generally be desirable to keep this ratio as low as possible consistent with achieving the desired herbicidal effectiveness..

The ratio of fluoro-organic surfactant, where present, to lecithin is preferably in the range from about 1:10 to about 10:1, more preferably in the range from about 1:3 to about 3:1 and most preferably around 1:1.The ranges disclosed herein can be used by one of skill in the art to prepare compositions of the invention having suitable concentrations and ratios of ingredients. Preferred or optimum concentrations and ratios of ingredients for any particular use or situation can be determined by routine experimentation.

Although the combination of the components might be done in a tank mix, it is preferred in the present invention that the combination be made further in advance of the application to the plant, in order to simplify the tasks required of the person who applies the material to plants. We have found, however, that in some cases the biological effectiveness of a liposome-containing composition prepared from scratch as a dilute spray composition is superior to that of a composition having the same ingredients at the same concentrations but diluted from a previously prepared concentrate formulation.

Although various compositions of the present invention are described herein as comprising certain listed materials, in some preferred embodiments of the invention the compositions consist essentially of the indicated materials.

Optionally, other agriculturally acceptable materials can be included in the compositions. For example, more than one exogenous chemical can be included. Also, various agriculturally acceptable adjuvants can be included, whether or not their purpose is to directly contribute to the effect of the exogenous chemical on a plant. For example, when the exogenous chemical is a herbicide, liquid nitrogen fertilizer or ammonium sulfate might be included in the composition. As another example, stabilizers can be added to the composition. In some instances it might be desirable to include microencapsulated acid in the composition, to lower the pH of a spray solution on contact with a leaf. One or more surfactants can also be included. Surfactants mentioned here by trade name, and other surfactants that can be useful in the method of the invention, are indexed in standard reference works such as McCutcheon's Emulsifiers and Detergents, 1997 edition, Handbook of Industrial Surfactants, 2nd Edition, 1997, published by Gower, and International Cosmetic Ingredient Dictionary, 6th Edition, 1995.

The compositions of the present invention can be applied to plants by spraying, using any conventional means for spraying liquids, such as spray nozzles, atomizers, or the like. Compositions of the present invention can be used in precision farming techniques, in which apparatus is employed to vary the amount of exogenous chemical applied to different parts of a field, depending on variables such as the particular plant species present, soil composition, and the like. In one embodiment of such techniques, a global positioning system operated with the spraying apparatus can be used to apply the desired amount of the composition to different parts of a field.

The composition at the time of application to plants is preferably dilute enough to be readily sprayed using standard agricultural spray equipment. Preferred application rates for the present

invention vary depending upon a number of factors, including the type and concentration of active ingredient and the plant species involved. Useful rates for applying an aqueous composition to a field of foliage can range from about 25 to about 1,000 liters per hectare (l/ha) by spray application. The preferred application rates for aqueous solutions are in the range from about 50 to about 300 l/ha.

Many exogenous chemicals (including glyphosate herbicide) must be taken up by living tissues of the plant and translocated within the plant in order to produce the desired biological (e.g., herbicidal) effect. Thus, it is important that a herbicidal composition not be applied in such a manner as to excessively injure and interrupt the normal functioning of the local tissue of the plant so quickly that translocation is reduced. However, some limited degree of local injury can be insignificant, or even beneficial, in its impact on the biological effectiveness of certain exogenous chemicals.

A large number of compositions of the invention are illustrated in the Examples that follow. Many concentrate compositions of glyphosate have provided sufficient herbicidal effectiveness in greenhouse tests to warrant field testing on a wide variety of weed species under a variety of application conditions. Water-in-oil-in-water multiple emulsion compositions tested in the field have included:

Field composition	Glyphosate g a.e./l	% w/w			% in inner aq. phase		Emulsifier #1	Emulsifier #2	Type of fatty acid ester
		Fatty acid ester	Emulsifier #1	Emulsifier #2	Water	Glyphosate			
F-1	100	18.0	3.0	5.0	13.8	20	Span 80	Tween 20	Bu stearate
F-2	100	7.5	3.0	5.0	5.6	20	Span 80	Tween 20	Bu stearate
F-3	100	7.5	3.0	5.0	5.6	0	Span 80	Tween 20	Bu stearate
F-4	160	7.5	3.0	5.0	5.6	0	Span 80	Tween 20	Bu stearate

The above compositions were prepared by process (vi) as described in the Examples.

Aqueous compositions tested in the field having an alkylether surfactant as the first excipient substance and/or containing a fatty acid ester have included:

Field composition	Glyphosate g a.e./l	% w/w		Type of surfactant	Type of fatty acid ester
		Fatty acid ester	Surfactant		
F-5	163	1.0	10.0	oleth-20	Bu stearate
F-6	163	1.0	10.0	Tween 80	Bu stearate
F-7	163	1.0	10.0	Neodol 25-20	Bu stearate
F-8	163	1.0	10.0	steareth-20	Bu stearate
F-9	163	1.0	10.0	Neodol 25-12	Bu stearate
F-10	105	7.5	10.0	Tween 80	Bu stearate
F-11	163	0.5	5.0	oleth-20	Bu stearate
F-12	163	0.3	5.0	oleth-20	Bu stearate
F-13	163	0.3	2.5	oleth-20	Bu stearate
F-14	163	1.0	10.0	Neodol 25-12	Bu stearate
F-15	163	0.3	5.0	Genapol UD-110	Bu stearate
F-16	163	0.5	5.0	steareth-20	Bu stearate
F-17	163	0.5	5.0	ceteth-20	Bu stearate

Field composition	Glyphosate g a.e./l	% w/w		Type of surfactant	Type of fatty acid ester
		Fatty acid ester	Surfactant		
F-18	163	0.5	5.0	laureth-23	Bu stearate
F-19	163	0.5	5.0	ceteareth-27	Bu stearate
F-20	163	0.5	5.0	Neodol 25-12	Bu stearate
F-21	163	0.5	5.0	Neodol 25-20	Bu stearate
F-22	163		5.0	steareth-20	
F-23	163		5.0	ceteth-20	
F-24	163		5.0	laureth-23	
F-25	163	0.3	5.0	ceteareth-27	Bu stearate
F-26	163	0.3	2.5	ceteareth-27	Bu stearate
F-27	163		5.0	ceteareth-27	
F-28	163	0.5	5.0	ceteareth-27	Me stearate
F-29	163	0.5	5.0	steareth-20	Me stearate
F-30	163	0.5	5.0	oleth-20	
F-31	163	0.5	5.0	Neodol 45-13	Bu stearate
F-32	163		5.0	Neodol 45-13	
F-33	163	0.5	5.0	ceteareth-15	Bu stearate
F-34	163		5.0	ceteareth-15	
F-35	163	0.5	5.0	steareth-30	Bu stearate

The above compositions were prepared by process (vii) if they contain fatty acid ester and by process (viii) if they do not. Both processes are described in the Examples.

Aqueous compositions tested in the field containing colloidal particulates have included:

Field composition	Glyphosate g a.e./l	% w/w				Type of surfactant	Type of colloidal particulate	Type of fatty acid ester	Other ingredients
		Fatty acid ester	Surfactant	Coll. partic.	Other				
F-36	360	1.0	10.0	1.3		steareth-20	Aerosil 380	Bu stearate	
F-37	360	1.0	10.0	1.3		oleth-20	Aerosil 380	Bu stearate	
F-38	360	1.0	10.0	1.3		steareth-30	Aerosil 380	Bu stearate	
F-39	360		10.0	1.3		steareth-30	Aerosil 380		
F-40	360			0.8			Aerosil 90		
F-41	350			0.8			Al oxide C		
F-42	360		3.0	0.8		Ethomeen T/25	Al oxide C		
F-43	360		3.0	0.1		Ethomeen T/25	Al oxide C		
F-44	360			0.3			Al oxide C		
F-45	360		3.0	0.3		Ethomeen T/25	Al oxide C		
F-46	360		6.0	0.8		Agrimul PG-2069	Al oxide C		
F-47	360		3.0	0.8		Tween 20	Al oxide C		
F-48	480		1.0	0.4		Neodol 1-7	Aerosil 90		
F-49	480		2.0	0.4		Agrimul PG-2069	Aerosil 90		
F-50	360	1.0	10.0	1.3		ceteareth-15	Aerosil 380	Bu stearate	

Field composition	Glyphosate g a.e./l	% w/w				Type of surfactant	Type of colloidal particulate	Type of fatty acid ester	Other ingredients
		Fatty acid ester	Surf-actant	Coll. partic.	Other				
F-51	360	1.0	10.0	1.3		ceteth-20	Aerosil 380	Bu stearate	
F-52	360	1.0	10.0	1.3		steareth-20	Aerosil 380	Bu stearate	
F-53	360	1.0	10.0	1.3		oleth-20	Aerosil 380	Bu stearate	
F-54	360	1.0	10.0	1.3		ceteareth-27	Aerosil 380	Bu stearate	
F-55	360	1.0	10.0	1.3		steareth-30	Aerosil 380	Bu stearate	
F-56	360		10.0	1.3		steareth-30	Aerosil 380		
F-57	360		10.0	1.3		ceteareth-27	Aerosil 380		
F-58	360		10.0	1.3		steareth-20	Aerosil 380		
F-59	360		10.0	1.3		oleth-20	Aerosil 380		
F-60	360	1.0	10.0	1.3		ceteareth-27	Aerosil 380	Me stearate	
F-61	360	1.0	10.0	1.3		ceteareth-27	Aerosil 380	Me palmitate	
F-62	300		10.0	1.3		ceteareth-27	Aerosil 380		
F-63	240		10.0	1.3		ceteareth-27	Aerosil 380		
F-64	360		6.0	1.3		ceteareth-27	Aerosil 380		
F-65	300		6.0	1.3		ceteareth-27	Aerosil 380		
F-66	240		6.0	1.3		ceteareth-27	Aerosil 380		
F-67	360			0.6			Aerosil 90		
F-68	360			3.1			Aerosil 90		
F-69	360			0.6			Al oxide C		
F-70	360			3.1			Al oxide C		
F-71	360			0.8			Aerosil 90		
F-72	360			0.8			Al oxide C		
F-73	360		3.0	0.8		Ethomeen T/25	Aerosil 90		
F-74	360		3.0	0.8		Ethomeen T/25	Al oxide C		
F-75	360		3.0	0.3		Ethomeen T/25	Al oxide C		
F-76	360		3.0	0.8		Ethomeen T/25	Nalco 1056		
F-77	360		3.0	0.8		Ethomeen C/25	Nalco 1056		
F-78	480		3.0 + 1.0	0.4		Ethomeen T/25 + Agrimul PG-2069	Al oxide C		
F-79	480		3.0 + 3.0	0.4		Ethomeen T/25 + Agrimul PG-2069	Al oxide C		
F-80	360		3.0	0.8		Agrimul PG-2069	Aerosil 90		
F-81	360		3.0	0.8		Tween 20	Aerosil 90		
F-82	360		3.1 + 3.1	0.8	7.1	Ethomeen T/25 + Tween 20	Aerosil 90		$(Bu)_4NOH$
F-83	360			0.8	7.1		Aerosil 90		$(Bu)_4NOH$
F-84	480		3.0	0.8		steareth-20	Aerosil 380		

Field composition	Glyphosate g a.e./l	% w/w Fatty acid ester	Surfactant	Coll. partic.	Other	Type of surfactant	Type of colloidal particulate	Type of fatty acid ester	Other ingredients
F-85	480		3.0	1.5		oleth-20	Aerosil 380		
F-86	480		3.0	1.5		oleth-20	Aerosil MOX-170		
F-87	480		3.0	1.5		oleth-20	Aerosil OX-50		
F-88	480		3.0	1.5		Velvetex AB-45	Aerosil 380		
F-89	480		3.0	1.5		steareth-20	Aerosil blend 2		
F-90	480		3.0	1.5		oleth-20	Aerosil blend 2		
F-91	480		4.5	1.5		oleth-20	Aerosil 380		
F-92	480		4.5	1.5		steareth-20	Aerosil 380		
F-93	480		3.0	1.5		steareth-20	Aerosil blend 1		
F-94	480		1.0	1.5		steareth-20	Aerosil blend 1		
F-95	480		6.0	1.5		steareth-20	Aerosil blend 1		
F-96	480		4.5	1.5	0.5	steareth-20	Aerosil blend 2		propylene glycol
F-97	480		6.0	1.5	0.5	steareth-20	Aerosil blend 2		propylene glycol
F-98	480		6.0	1.5	0.5	oleth-20	Aerosil blend 2		propylene glycol
F-99	480		4.5 + 2.3	1.5	0.5	steareth-20 + Ethomeen T/25	Aerosil blend 2		propylene glycol
F-100	480		6.0	1.5		steareth-20	Al oxide C		
F-101	480		4.5 + 2.3	1.5	0.5	steareth-20 + Ethomeen T/25	Al oxide C		propylene glycol
F-102	480		4.5 + 1.0	1.5	0.5	steareth-20 + Ethomeen T/25	Al oxide C		propylene glycol
F-103	480		3.0	1.5		steareth-20	Aerosil 380		
F-104	480		4.5	1.5		steareth-20	Al oxide C		
F-105	480		6.0	1.5		steareth-20	Aerosil 380		
F-106	480		4.5 + 1.0	1.5	0.5	steareth-20 + Ethomeen T/25	Aerosil 380		propylene glycol
F-107	480		4.5 + 2.3	1.5	0.5	steareth-20 + Ethomeen T/25	Aerosil 380		propylene glycol
F-108	480		4.5	1.5		steareth-20	Aerosil blend 2		

Field composition	Glyphosate g a.e./l	% w/w				Type of surfactant	Type of colloidal particulate	Type of fatty acid ester	Other ingredients
		Fatty acid ester	Surf-actant	Coll. partic.	Other				
F-109	480		6.0	1.5		steareth-20	Aerosil blend 2		
F-110	480		4.5 + 1.0	1.5	0.5	steareth-20 + Ethomeen T/25	Aerosil blend 2		propylene glycol
F-111	480		4.5	1.5		steareth-30	Aerosil blend 2		
F-112	480		4.5 + 1.0	1.5	0.5	steareth-20 + Ethomeen T/25	Aerosil blend 2		propylene glycol
F-113	480		6.0	1.5		steareth-30	Aerosil blend 2		
F-114	480		4.5 + 2.3	1.5	0.5	steareth-20 + Ethomeen T/25	Aerosil blend 2		propylene glycol
F-115	480		10.0	1.5		steareth-20	Aerosil blend 2		
F-116	480		4.5	1.5		ceteareth-27	Aerosil 380		
F-117	480		6.0	1.5		ceteareth-27	Aerosil 380		
F-118	480		4.5	1.5		ceteareth-27	Aerosil blend 2		
F-119	480		6.0	1.5		ceteareth-27	Aerosil blend 2		
F-120	480		4.5	1.5		ceteareth-27	Al oxide C		
F-121	480		6.0	1.5		ceteareth-27	Al oxide C		

Aerosil blend 1: Aerosil MOX-80 + Aerosil MOX-170 (1:1)
Aerosil blend 2: Aerosil MOX-80 + Aerosil 380 (1:2)

The above compositions were prepared by process (ix) as described in the Examples.

Aqueous compositions tested in the field having soybean lecithin (45% phospholipid, Avanti) as the first excipient substance and a cationic fluoro-organic surfactant as the second excipient substance have included:

Field composition	Glyphosate g a.e./l	% w/w			
		Lecithin	Fluorad FC-135	Fluorad FC-754	MON 0818
F-122	167	6.0	8.3		4.0
F-123	168	6.0		8.3	4.0
F-124	228	2.0		2.0	0.5
F-125	347	3.0		3.0	0.5
F-126	344	1.0		1.0	0.5
F-127	111	8.0	8.0		0.5
F-128	228	6.0		3.0	6.0
F-129	228	6.0		6.0	6.0
F-130	228	3.3		5.0	0.5
F-131	228	5.0		5.0	0.8

Field composition	Glyphosate g a.e./l	% w/w			
		Lecithin	Fluorad FC-135	Fluorad FC-754	MON 0818
F-132	372	3.0		3.0	0.8
F-133	372	3.0		5.0	0.8
F-134	372	3.0		12.0	0.8

The above compositions were prepared by process (v) as described in the Examples.

Aqueous compositions tested in the field having soybean lecithin (45% phospholipid, Avanti) as the first excipient substance and fatty acid ester as the second excipient substance have included:

Field composition	Glyphosate g a.e./l	% w/w				Type of surfactant	Type of fatty acid ester
		Lecithin	MON 0818	Fatty acid ester	Surfactant		
F-135	360	0.5	6.0	7.5	6.0	Ethomeen T/25	Bu stearate
F-136	360	6.0	4.5	1.5	3.0 + 4.5	ceteareth-27 + Ethomeen T/25	Bu stearate
F-137	228	6.0	3.0	1.5	3.0	Ethomeen T/25	Bu stearate
F-138	228	0.8		3.8	3.0 + 3.0	ceteareth-27 + Ethomeen T/25	Bu stearate
F-139	228	1.5		1.5	3.0 + 3.0	ceteareth-27 + Ethomeen T/25	Bu stearate
F-140	228	6.7	0.8	0.7	0.8	Ethomeen T/25	Bu stearate
F-141	228	6.7	1.7	0.7	1.7	Ethomeen T/25	Bu stearate
F-142	228	6.7	3.3	0.7	3.3	Ethomeen T/25	Bu stearate
F-143	228	3.3	0.8	0.7	0.8	Ethomeen T/25	Bu stearate
F-144	228	3.3	1.7	0.7	1.7	Ethomeen T/25	Bu stearate
F-145	228	3.3	2.5	0.7	2.5	Ethomeen T/25	Bu stearate
F-146	228	3.3	3.3	0.7	3.3	Ethomeen T/25	Bu stearate
F-147	228	6.7	2.5	0.7	2.5	Ethomeen T/25	Bu stearate
F-148	228		3.0	0.5	3.0	Ethomeen T/25	Bu stearate
F-149	228	2.0	2.5	0.5	2.5	Ethomeen T/25	Bu stearate
F-150	228	4.0	6.0	0.5			Bu stearate
F-151	228	4.0	6.0	2.0			Bu stearate
F-152	228	4.0	6.0	1.0			Bu stearate
F-153	228	2.0	2.0	0.5			Bu stearate
F-154	228	2.0	4.0	0.5			Bu stearate
F-155	228		6.0	0.5			Bu stearate

The above compositions were prepared by process (x) as described in the Examples.

Dry compositions tested in the field have included:

Field composition	% w/w						Type of surfactant	Type of colloidal particulate	Other ingredients
	Glyphosate a.e.	Lecithin	Butyl stearate	Surfactant	Coll. partic.	Other			
F-156	64			25.0	2.0		steareth-20	Aerosil blend 1	
F-157	68			20.0	2.0		steareth-20	Aerosil blend 1	

Field composition	% w/w						Type of surfactant	Type of colloidal particulate	Other ingredients
	Glyphosate a.e.	Lecithin	Butyl stearate	Surfactant	Coll. partic.	Other			
F-158	72			15.0	2.0		steareth-20	Aerosil blend 1	
F-159	64			25.0	1.0		ceteth-20	Aerosil 380	
F-160	65			25.0	1.0		steareth-20	Aerosil 380	
F-161	65			25.0	1.0		oleth-20	Aerosil 380	
F-162	67	10.0		10.0 + 1.5	1.0		Fluorad FC-754 + Ethomeen T/25	Aerosil 380	
F-163	73	7.0		7.0 + 1.5	1.0		Fluorad FC-754 + Ethomeen T/25	Aerosil 380	
F-164	64	12.0	3.0	12.0			MON 0818		
F-165	64	6.7	6.7	13.2			MON 0818		
F-166	68			20.0	2.0		steareth-20	Aerosil blend 1	
F-167	66		2.0	20.0	2.0		steareth-20	Aerosil blend 1	
F-168	68			20.0	2.0		oleth-20	Aerosil blend 1	
F-169	66		2.0	20.0	2.0		oleth-20	Aerosil blend 1	
F-170	66		2.0	20.0	2.0		ceteareth-27	Aerosil blend 1	
F-171	48			14.1		36.1	ceteareth-27		NH_4 phosphate
F-172	65			20.0		5.0	ceteareth-27		Na acetate
F-173	70			20.0			ceteareth-27		

Aerosil blend 1: Aerosil MOX-80 + Aerosil MOX-170 (1:1)

The above compositions were prepared by the process described for dry granular compositions in the Examples.

EXAMPLES

In the following Examples illustrative of the invention, greenhouse tests were conducted to evaluate relative herbicidal effectiveness of glyphosate compositions. Compositions included for comparative purposes included the following:

Formulation B: which consists of 41% by weight of glyphosate IPA salt in aqueous solution. This formulation is sold in the USA by Monsanto Company under the ACCORD® trademark.

Formulation C: which consists of 41% by weight of glyphosate IPA salt in aqueous solution with a coformulant (15% by weight) of a surfactant (MON 0818 of Monsanto Company) based on

polyoxyethylene (15) tallowamine. This formulation is sold in Canada by Monsanto Company under the ROUNDUP® trademark.

Formulation J: which consists of 41% by weight of glyphosate IPA salt in aqueous solution, together with surfactant. This formulation is sold in the USA by Monsanto Company under the ROUNDUP® ULTRA trademark.

Formulation K: which consists of 75% by weight of glyphosate ammonium salt together with surfactant, as a water-soluble dry granular formulation. This formulation is sold in Australia by Monsanto Company under the ROUNDUP® DRY trademark.

Formulations B, C and J contain 356 grams of glyphosate acid equivalent per liter (g a.e./l). Formulation K contains 680 grams of glyphosate acid equivalent per kilogram (g a.e./kg).

Various proprietary excipients were used in compositions of the Examples. They may be identified as follows:

Trade name	Manufacturer	Chemical description
Aerosil 90	Degussa	amorphous silica, 90 m^2/g
Aerosil 200	Degussa	amorphous silica, 200 m^2/g
Aerosil 380	Degussa	amorphous silica, 380 m^2/g
Aerosil MOX-80	Degussa	amorphous silica/aluminum oxide, 80 m^2/gm
Aerosil MOX-170	Degussa	amorphous silica/aluminum oxide, 170 m^2/g
Aerosil OX-50	Degussa	amorphous silica, 50 m^2/g
Aerosil R-202	Degussa	amorphous hydrophobic silica (dimethylsiloxane surface group)
Aerosil R-805	Degussa	amorphous hydrophobic silica (octyl surface group)
Aerosil R-812	Degussa	amorphous hydrophobic silica (trimethylsilyl surface group)
Aerosol OS	Cytec	diisopropyl naphthalene sulfonate, Na salt
Aerosol OT	Cytec	dioctyl sulfosuccinate, Na salt
Agrimer AL-25	ISP	1-ethenyl hexadecyl-2-pyrrolidinone
Agrimer AL-30	ISP	1-ethenyl-2-pyrrolidinone polymer
Agrimul PG-2069	Henkel	C_{9-11} alkylpolyglycoside
Alcodet 218	Rhone-Poulenc	isolauryl 10EO thioether
Aluminum oxide C	Degussa	aluminum oxide, 100 m^2/g
Amidox L-5	Stepan	lauramide 5EO
Ammonyx CO	Stepan	palmitamine oxide
Ammonyx LO	Stepan	lauramine oxide
Arcosolve DPM	Arco	dipropyleneglycol monomethyl ether
Diacid 1550	Westvaco	cyclocarboxypropyl oleic acid
Dowanol PNB	Dow	propylene glycol n-butyl ether
Dowanol TPNB	Dow	tripropylene glycol n-butyl ether
Emerest 2421	Henkel	glyceryl oleate
Emerest 2661	Henkel	PEG-12 laurate
Emid 6545	Henkel	oleic diethanolamide
Emphos CS-121	Witco	alkylaryl ethoxylate phosphate ester
Emphos CS-131	Witco	alkylaryl ethoxylate phosphate ester
Emphos CS-141	Witco	nonylphenol 10EO phosphate
Emphos CS-330	Witco	alkylaryl ethoxylate phosphate ester
Emphos PS-21A	Witco	alcohol ethoxylate phosphate ester
Emphos PS-121	Witco	linear alcohol ethoxylate phosphate ester, acid form
Emphos PS-400	Witco	linear alcohol ethoxylate phosphate ester, acid form

Trade name	Manufacturer	Chemical description
Ethomeen C/12	Akzo	cocoamine 2EO
Ethomeen C/25	Akzo	cocoamine 15EO
Ethomeen T/12	Akzo	tallowamine 2EO
Ethomeen T/25	Akzo	tallowamine 15EO
Ethoquad T/20	Akzo	methyltallowammonium chloride 10EO
Exxate 700	Exxon	C_7 alkyl acetate
Exxate 1000	Exxon	C_{10} alkyl acetate
Exxol D-130	Exxon	dearomatized aliphatic solvent
Fluorad FC-120	3M	C_{9-10} perfluoroalkyl sulfonate, NH4 salt
Fluorad FC-129	3M	fluorinated alkyl carboxylate, K salt
Fluorad FC-135	3M	fluorinated alkyl quaternary ammonium iodide
Fluorad FC-170C	3M	fluorinated alkanol EO
Fluorad FC-171	3M	fluorinated alkanol EO
Fluorad FC-431	3M	fluorinated alkyl ester
Fluorad FC-750	3M	fluorinated alkyl quaternary ammonium iodide
Fluorad FC-751	3M	fluorinated amphoteric surfactant
Fluorad FC-754	3M	fluorinated alkyl quaternary ammonium chloride
Fluorad FC-760	3M	fluorinated alkanol EO
Genapol UD-030	Hoechst	C_{11} oxo alcohol 3EO
Genapol UD-110	Hoechst	C_{11} oxo alcohol 11EO
Isopar V	Exxon	isoparaffinic oil
Kelzan	Monsanto	xanthan gum
LI-700	Loveland	lecithin-based adjuvant
Makon 4	Stepan	nonylphenol 4EO
Makon 6	Stepan	nonylphenol 6EO
Makon 30	Stepan	nonylphenol 30EO
Makon NF-5	Stepan	polyalkoxylated aliphatic base
MON 0818	Monsanto	tallowamine 15EO-based surfactant
Myrj 52	ICI	PEG-40 stearate
Myrj 59	ICI	PEG-100 stearate
Nalco 1056	Nalco	silica (26%)/aluminum oxide (4%); average particle size 20 nm
Neodol 1-12	Shell	C_{11} linear alcohol 12EO
Neodol 1-7	Shell	C_{11} linear alcohol 7EO
Neodol 1-9	Shell	C_{11} linear alcohol 9EO
Neodol 25-12	Shell	C_{12-15} linear alcohol 12EO
Neodol 25-20	Shell	C_{12-15} linear alcohol 20EO
Neodol 25-3	Shell	C_{12-15} linear alcohol 3EO
Neodol 25-7	Shell	C_{12-15} linear alcohol 7EO
Neodol 25-9	Shell	C_{12-15} linear alcohol 9EO
Neodol 45-13	Shell	C_{14-15} linear alcohol 13EO
Neodol 91-2.5	Shell	C_{9-11} linear alcohol 2.5EO
Neodox 25-11	Shell	C_{12-15} linear alcohol ethoxycarboxylate 11EO
Ninate 411	Stepan	amine dodecylbenezene sulfonate
Ninol 40-CO	Stepan	coco diethanolamide
Orchex 796	Exxon	paraffinic oil
Pluronic 31-R1	BASF	21PO-7EO-21PO block copolymer
Pluronic F-108	BASF	128EO-54PO-128EO block copolymer
Pluronic F-127	BASF	98EO-67PO-98EO block copolymer
Pluronic F-68	BASF	75EO-30PO-75EO block copolymer
Pluronic L-35	BASF	11EO-16PO-11EO block copolymer

Trade name	Manufacturer	Chemical description
Pluronic L-43	BASF	7EO-21PO-7EO block copolymer
Pluronic L-81	BASF	6EO-39PO-6EO block copolymer
Pluronic P-84	BASF	27EO-39PO-27EO block copolymer
Polystep B-25	Stepan	decyl sulfate, Na salt
Reax 88B	Westvaco	highly sulfonated lignin, Na salt
Sident 9	Degussa	abrasive silica, 50 m^2/g
Silwet 800	Witco	heptamethyltrisiloxane EO
Silwet L-77	Witco	heptamethyltrisiloxane 7EO methyl ether
Simulsol SL-4	Seppic	alkyl polyglucoside
Simulsol SL-10	Seppic	alkyl polyglucoside
Simulsol SL-62	Seppic	alkyl polyglucoside
Sipernat 22	Degussa	hydrophilic precipitated silica, 190 m^2/g, av. aggregate size 100 μm
Sipernat 22S	Degussa	hydrophilic precipitated silica, 190 m^2/g, av. aggregate size <10 μm
Span 60	ICI	sorbitan monostearate
Span 65	ICI	sorbitan tristearate
Span 80	ICI	sorbitan monooleate
Span 85	ICI	sorbitan trioleate
Steol CS-370	Stepan	lauryl EO sulfate, Na salt
Stepanol WAC	Stepan	lauryl sulfate, Na salt
Stepfac 8170	Stepan	nonylphenol EO phosphate
Surfynol 104	Air Products	tetramethyldecyne diol
Surfynol 465	Air Products	tetramethyldecyne diol 10EO
Tergitol 15-S-15	Union Carbide	C_{15} branched secondary alcohol 15EO
Tergitol 15-S-20	Union Carbide	C_{15} branched secondary alcohol 20EO
Tergitol 15-S-30	Union Carbide	C_{15} branched secondary alcohol 30EO
Tergitol 15-S-40	Union Carbide	C_{15} branched secondary alcohol 40EO
Titanium dioxide P25	Degussa	titanium dioxide, average particle size 21 nm
Toximul 8240	Stepan	PEG-36 castor oil
Toximul 8302	Stepan	alcohol EO blend
Triton RW-20	Union Carbide	alkylamine 2EO
Triton RW-50	Union Carbide	alkylamine 5EO
Triton RW-75	Union Carbide	alkylamine 7.5EO
Triton RW-100	Union Carbide	alkylamine 10EO
Triton RW-150	Union Carbide	alkylamine 15EO
Tryfac 5552	Henkel	decyl EO phosphate, free acid
Tween 20	ICI	sorbitan monolaurate 20EO
Tween 40	ICI	sorbitan monopalmitate 20EO
Tween 80	ICI	sorbitan monooleate 20EO
Tween 85	ICI	sorbitan trioleate 20EO
Velvetex AB-45	Henkel	cocobetaine
Westvaco H-240	Westvaco	dicarboxylate surfactant, K salt

Fluorad FC-135, though defined only generically as above in 3M product literature and in standard directories, has been specifically identified as

$$C_8F_{17}SO_2NH(CH_2)_3N^+(CH_3)_3\ I^-$$

in a paper by J. Linert & J. N. Chasman of 3M, titled "The effects of fluorochemical surfactants on recoatability" in the December 20, 1993 issue of American Paint & Coatings Journal, and reprinted as a trade brochure by 3M. Fluorad FC-750 is believed to be based on the same surfactant. Fluorad FC-754 is believed to have the structure

$C_8F_{17}SO_2NH(CH_2)_3N^+(CH_3)_3\ Cl^-$

that is, identical to Fluorad FC-135 but with a chloride anion replacing iodide.

The following surfactants, identified in the Examples as "Surf H1" to "Surf H5", have hydrocarbyl groups as the hydrophobic moiety but otherwise bear some structural similarity to the above Fluorad surfactants. They were synthesized and characterized under contract to Monsanto Company.

Surf H1: $C_{12}H_{25}SO_2NH(CH_2)_3N^+(CH_3)_3\ I^-$

Surf H2: $C_{17}H_{35}CONH(CH_2)_3N^+(CH_3)_3\ I^-$

Surf H3: $C_{11}H_{23}CONH(CH_2)_3N^+(CH_3)_3\ I^-$

Surf H4: cis-$C_8H_{17}CH{=}CH(CH_2)_7CONH(CH_2)_3N^+(CH_3)_3\ I^-$

Surf H5: $C_7H_{15}CONH(CH_2)_3N^+(CH_3)_3\ I^-$

Fatty alcohol ethoxylate surfactants are referred to in the Examples by their generic names as given in the International Cosmetic Ingredient Dictionary, 6th Edition, 1995 (Cosmetic, Toiletry and Fragrance Association, Washington, DC). They were interchangeably sourced from various manufacturers, for example:

Laureth-23: Brij 35 (ICI), Trycol 5964 (Henkel).

Ceteth-10: Brij 56 (ICI).

Ceteth-20: Brij 58 (ICI).

Steareth-10: Brij 76 (ICI).

Steareth-20: Brij 78 (ICI), Emthox 5888-A (Henkel), STA-20 (Heterene).

Steareth-30: STA-30 (Heterene).

Steareth-100: Brij 700 (ICI).

Ceteareth-15: CS-15 (Heterene).

Ceteareth-20: CS-20 (Heterene).

Ceteareth-27: Plurafac A-38 (BASF).

Ceteareth-55: Plurafac A-39 (BASF).

Oleth-2: Brij 92 (ICI).

Oleth-10: Brij 97 (ICI).

Oleth-20: Brij 98 (ICI), Trycol 5971 (Henkel).

Where a proprietary excipient is a surfactant supplied as a solution in water or other solvent, the amount to be used was calculated on a true surfactant basis, not an "as is" basis. For example, Fluorad FC-135 is supplied as 50% true surfactant, together with 33% isopropanol and 17% water; thus to

provide a composition containing 0.1% w/w Fluorad FC-135 as reported herein, 0.2 g of the product as supplied was included in 100 g of the composition.

Spray compositions of the Examples contained an exogenous chemical, such as glyphosate IPA salt, in addition to the excipient ingredients listed. The amount of exogenous chemical was selected to provide the desired rate in grams per hectare (g/ha) when applied in a spray volume of 93 l/ha. Several exogenous chemical rates were applied for each composition. Thus, except where otherwise indicated, when spray compositions were tested, the concentration of exogenous chemical varied in direct proportion to exogenous chemical rate, but the concentration of excipient ingredients was held constant across different exogenous chemical rates.

Concentrate compositions were tested by dilution, dissolution or dispersion in water to form spray compositions. In these spray compositions prepared from concentrates, the concentration of excipient ingredients varied with that of exogenous chemical.

Except where otherwise indicated, these aqueous spray compositions were prepared by one of the following processes (i), (ii) or (iii).

(i) For compositions not containing lecithin or phospholipids, aqueous compositions were prepared by simple mixing of ingredients under mild agitation.

(ii) A weighed quantity of lecithin in powder form was dissolved in 0.4 ml chloroform in a 100 ml bottle. The resulting solution was air-dried to leave a thin film of lecithin, to which was added 30 ml deionized water. The bottle and its contents were then sonicated in a Fisher Sonic Dismembrator, Model 550, fitted with a 2.4 cm probe tip, set at output level 8, and operated continuously for 3 minutes. The resulting aqueous dispersion of lecithin was then allowed to cool to room temperature, and formed a lecithin stock which was later mixed in the required amounts with other ingredients under mild agitation. In some cases, as indicated in the Examples, certain ingredients were added to the lecithin in water before sonication, so that the lecithin and these ingredients were sonicated together. Without being bound by theory, it is believed that by sonicating a formulation ingredient together with lecithin, at least some of that ingredient becomes encapsulated within, or otherwise bound to or trapped by, vesicles or other aggregates formed by phospholipids present in the lecithin.

(iii) The procedure of process (ii) was followed except that, before sonication, the step of forming a lecithin solution in chloroform was omitted. Instead, lecithin in powder form was placed in a beaker, water was added and the beaker and its contents were then sonicated.

Except where otherwise indicated, aqueous concentrate compositions were prepared by one of the following processes (iv) to (x).

(iv) A weighed amount of lecithin powder of the type indicated was placed in a beaker and deionized water was added in no more than the amount required for the desired final composition. The beaker and its contents were then placed in a Fisher Sonic Dismembrator, Model 550, fitted with a 2.4 cm probe tip, set at output level 8, and operated for 5 minutes. The resulting lecithin dispersion formed

the basis to which other ingredients were added with mild agitation to make the aqueous concentrate formulation. The order of addition of these ingredients was varied and was sometimes found to affect the physical stability of the concentrate formulation. Where a fluoro-organic surfactant such as Fluorad FC-135 or FC-754 was to be included, it was generally added first, followed by other surfactants if required and then by the exogenous chemical. Where the exogenous chemical used was glyphosate IPA salt, this was added in the form of a 62% (45% a.e.) solution by weight, at a pH of 4.4 to 4.6. A final adjustment with water took place if necessary as the last step. In some cases certain ingredients of the concentrate formulation were added before rather than after sonication, so that they were sonicated with the lecithin.

(v) A weighed amount of lecithin powder of the type indicated was placed in a beaker and deionized water was added in sufficient quantity to provide, after sonication as detailed below, a lecithin stock at a convenient concentration, normally in the range from 10% to 20% w/w and typically 15% w/w. The beaker and its contents were then placed in a Fisher Sonic Dismembrator, Model 550, fitted with a 2.4 cm probe tip with the pulse period set at 15 seconds with 1 minute intervals between pulses to allow cooling. Power output was set at level 8. After a total of 3 minutes of sonication (12 pulse periods) the resulting lecithin stock was finally adjusted to the desired concentration if necessary with deionized water. To prepare an aqueous concentrate formulation, the following ingredients were mixed in the appropriate proportions with mild agitation, normally in the order given although this was sometimes varied and was found in some cases to affect the physical stability of the concentrate formulation: (a) exogenous chemical, for example glyphosate IPA salt as a 62% w/w solution at pH 4.4-4.6; (b) lecithin stock; (c) other ingredients if required; and (d) water.

(vi) Water-in-oil-in-water (W/O/W) multiple emulsions were prepared as follows. First a water-in-oil emulsion was prepared. To do this, the required amounts of the selected oil and a first emulsifier (referred to in the Examples as "emulsifier #1") were mixed thoroughly. If it was desired to prepare the formulation with glyphosate in the inner aqueous phase, a measured amount of concentrated (62% w/w) aqueous solution of glyphosate IPA salt was added to the mixture of oil and first emulsifier with agitation to ensure homogeneity. The amount of water required in the inner aqueous phase was then added to complete the water-in-oil emulsion, which was finally subjected to high-shear mixing, typically using a Silverson L4RT-A mixer fitted with a fine emulsor screen operated for 3 minutes at 10,000 rpm. The required amount of a second emulsifier (referred to in the Examples as "emulsifier #2") was next added to the water-in-oil emulsion with agitation to ensure homogeneity. If it was desired to prepare the formulation with glyphosate in the outer aqueous phase, a measured amount of concentrated (62% w/w) aqueous solution of glyphosate IPA salt was added to the blend of the water-in-oil emulsion and the second emulsifier with further agitation. To complete the water-in-oil-in-water multiple emulsion composition, the amount of water required in the outer aqueous phase was added. The composition was

finally subjected to high-shear mixing, typically using a Silverson L4RT-A mixer fitted with a medium emulsor screen, operated for 3 minutes at 7,000 rpm.

(vii) Oil-in-water (O/W) emulsions were prepared as follows. The required amount of the selected oil and surfactant (sometimes referred to in the Examples as "emulsifier #2" as it corresponds to the second emulsifier in process (vi)) were mixed thoroughly. If the surfactant selected was not free-flowing at ambient temperature, heat was applied to bring the surfactant into a flowable condition before mixing with the oil. A measured amount of concentrated (62% w/w) aqueous solution of glyphosate IPA salt was added to the surfactant-oil mixture with agitation. The required amount of water was added to bring the concentration of glyphosate and other ingredients to the desired level . The composition was finally subjected to high-shear mixing, typically using a Silverson L4RT-A mixer fitted with a medium emulsor screen, operated for 3 minutes at 7,000 rpm.

(viii) Surfactant-containing aqueous solution concentrates having no oil component were prepared as follows. A concentrated (62% w/w) aqueous solution of glyphosate IPA salt was added in the desired amount to a weighed quantity of the selected surfactant(s). If the surfactant selected is not free-flowing at ambient temperature, heat was applied to bring the surfactant into a flowable condition before adding the glyphosate solution. The required amount of water was added to bring the concentration of glyphosate and other ingredients to the desired level. The composition was finally subjected to high-shear mixing, typically using a Silverson L4RT-A mixer fitted with a medium emulsor screen, operated for 3 minutes at 7,000 rpm.

(ix) For compositions containing a colloidal particulate, the required amount by weight of the selected colloidal particulate was suspended in a concentrated (62% w/w) aqueous solution of glyphosate IPA salt and agitated with cooling to ensure homogeneity. To the resulting suspension was added the required amount by weight of the selected surfactant(s). For a surfactant which is not free-flowing at ambient temperature, heat was applied to bring the surfactant into a flowable condition before adding it to the suspension. In those instances where an oil, such as butyl stearate, was also to be included in the composition, the oil was first thoroughly mixed with the surfactant and the surfactant-oil mixture added to the suspension. To complete the aqueous concentrate, the required amount of water was added to bring the concentration of glyphosate and other ingredients to the desired level. The concentrate was finally subjected to high-shear mixing, typically using a Silverson L4RT-A mixer fitted with a medium emulsor screen, operated for 3 minutes at 7,000 rpm.

(x) The procedure for preparing aqueous concentrate formulations containing lecithin and butyl stearate was different from that followed for other lecithin-containing concentrates. Exogenous chemical, for example glyphosate IPA salt, was first added, with mild agitation, to deionized water in a formulation jar. The selected surfactant (other than lecithin) was then added, while continuing the agitation, to form a preliminary exogenous chemical/ surfactant mixture. Where the surfactant is not free-flowing at ambient temperature, the order of addition was not as above. Instead, the non-free-

flowing surfactant was first added to water together with any other surfactant (other than lecithin) required in the composition, and was then heated to 55°C in a shaker bath for 2 hours. The resulting mixture was allowed to cool, then exogenous chemical was added with mild agitation to form the preliminary exogenous chemical/surfactant mixture. A weighed amount of the selected lecithin was added to the preliminary exogenous chemical/surfactant mixture, with stirring to break up lumps. The mixture was left for about 1 hour to allow the lecithin to hydrate, then butyl stearate was added, with further stirring until no phase separation occurred. The mixture was then transferred to a microfluidizer (Microfluidics International Corporation, Model M-110F) and microfluidized for 3 to 5 cycles at 10,000 psi (69 MPa). In each cycle, the formulation jar was rinsed with microfluidized mixture. In the last cycle, the finished composition was collected in a clean dry beaker.

The following procedure was used for testing compositions of the Examples to determine herbicidal effectiveness, except where otherwise indicated.

Seeds of the plant species indicated were planted in 85 mm square pots in a soil mix which was previously steam sterilized and prefertilized with a 14-14-14 NPK slow release fertilizer at a rate of 3.6 kg/m3. The pots were placed in a greenhouse with sub-irrigation. About one week after emergence, seedlings were thinned as needed, including removal of any unhealthy or abnormal plants, to create a uniform series of test pots.

The plants were maintained for the duration of the test in the greenhouse where they received a minimum of 14 hours of light per day. If natural light was insufficient to achieve the daily requirement, artificial light with an intensity of approximately 475 microeinsteins was used to make up the difference. Exposure temperatures were not precisely controlled but averaged about 27°C during the day and about 18°C during the night. Plants were sub-irrigated throughout the test to ensure adequate soil moisture levels.

Pots were assigned to different treatments in a fully randomized experimental design with 3 replications. A set of pots was left untreated as a reference against which effects of the treatments could later be evaluated.

Application of glyphosate compositions was made by spraying with a track sprayer fitted with a 9501E nozzle calibrated to deliver a spray volume of 93 liters per hectare (l/ha) at a pressure of 166 kilopascals (kPa). After treatment, pots were returned to the greenhouse until ready for evaluation.

Treatments were made using dilute aqueous compositions. These could be prepared as spray compositions directly from their ingredients, or by dilution with water of preformulated concentrate compositions.

For evaluation of herbicidal effectiveness, all plants in the test were examined by a single practiced technician, who recorded percent inhibition, a visual measurement of the effectiveness of each treatment by comparison with untreated plants. Inhibition of 0% indicates no effect, and inhibition of 100% indicates that all of the plants are completely dead. Inhibition of 85% or more is in most cases

considered acceptable for normal herbicidal use; however in greenhouse tests such as those of the Examples it is normal to apply compositions at rates which give less than 85% inhibition, as this makes it easier to discriminate among compositions having different levels of effectiveness.

EXAMPLE 1

Glyphosate-containing spray compositions were prepared by tank-mixing Formulations B and C with excipients as shown in Table 1.

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and 16 days after planting ECHCF, and evaluation of herbicidal inhibition was done 18 days after application. Results, averaged for all replicates of each treatment, are shown in Table 1.

Table 1

Glyphosate composition	Glyphosate rate g a.e./ha	Additive	Additive rate % v/v	% Inhibition	
				ABUTH	ECHCF
Formulation C	175	none		40	75
	350			69	89
	500			97	100
Formulation B	175	none		45	37
	350			73	66
	500			83	97
Formulation B	175	L-77	0.25	64	30
	175		0.50	77	27
Formulation B	175	FC-135	0.25	55	72
	175		0.50	73	61
Formulation B	175	FC-135 + L-77 8:1	0.50	71	58
	175	FC-135 + L-77 4:1	0.50	76	61
	175	FC-135 + L-77 2:1	0.50	63	56
	175	FC-135 + L-77 1:1	0.50	77	40
	175	FC-135 + L-77 1:2	0.50	54	23
	175	FC-135 + L-77 1:4	0.50	76	31
	175	FC-135 + L-77 1:8	0.50	53	29
Formulation B	175	FC-135 + L-77 8:1	0.25	51	48
	175	FC-135 + L-77 4:1	0.25	37	47
	175	FC-135 + L-77 2:1	0.25	45	37
	175	FC-135 + L-77 1:1	0.25	65	27
	175	FC-135 + L-77 1:2	0.25	45	29
	175	FC-135 + L-77 1:4	0.25	60	17
	175	FC-135 + L-77 1:8	0.25	52	15

Tank mixtures of Fluorad FC-135 with Formulation B gave markedly superior herbicidal effectiveness on ABUTH by comparison with Formulation C, but did not match the herbicidal effectiveness of Formulation C on ECHCF. The antagonism of glyphosate activity on ECHCF seen with

the nonionic organosilicone surfactant Silwet L-77 did not occur with the cationic fluoro-organic surfactant Fluorad FC-135.

EXAMPLE 2

Aqueous spray compositions were prepared containing glyphosate sodium or IPA salts and excipient ingredients as shown in Table 2a. Process (ii) was followed for all compositions, using soybean lecithin (10-20% phospholipid, Sigma Type II-S). Without adjustment, the pH of the compositions was approximately 5. For those compositions having a pH of approximately 7 as shown in Table 2a, the pH was adjusted using the same base (sodium hydroxide or IPA) that formed the glyphosate salt.

Table 2a

Spray composition	Lecithin g/l	% w/w		Components sonicated with lecithin	Glyphosate salt	pH
		Fluorad FC-135	L-77			
2-01	5.0			none	IPA	5
2-02	5.0		0.50	none	IPA	5
2-03	5.0			none	Na	7
2-04	5.0		0.50	none	Na	7
2-05	5.0			none	IPA	7
2-06	5.0		0.50	none	IPA	7
2-07	5.0			none	Na	5
2-08	5.0		0.50	none	Na	5
2-09	2.5			none	IPA	5
2-10	2.5	0.50		none	IPA	5
2-11	5.0	0.50		none	IPA	5
2-12	5.0	0.33	0.17	none	IPA	5
2-13	5.0		0.50	L-77	IPA	5
2-14	5.0		0.50	L-77	Na	7
2-15	5.0		0.50	L-77	IPA	7
2-16	5.0		0.50	L-77	Na	5

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 17 days after application.

Formulation C, alone and tank mixed with 0.5% Silwet L-77, were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 2b.

Table 2b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation C	100	8	54
	200	54	75
	300	77	90

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation C + Silwet L-77 0.5% v/v	100	62	10
	200	91	25
	300	95	27
2-01	100	59	64
	200	74	83
	300	82	99
2-02	100	66	44
	200	73	45
	300	92	76
2-03	100	17	29
	200	37	72
	300	70	89
2-04	100	48	24
	200	67	50
	300	81	61
2-05	100	40	44
	200	77	89
	300	79	95
2-06	100	76	43
	200	87	74
	300	90	85
2-07	100	40	50
	200	66	54
	300	84	83
2-08	100	69	34
	200	57	70
	300	78	66
2-09	100	44	62
	200	83	82
	300	90	91
2-10	100	84	83
	200	97	85
	300	95	93
2-11	100	79	65
	200	89	84
	300	98	98
2-12	100	74	63
	200	93	84
	300	94	92
2-13	100	86	85
	200	91	92
	300	97	97
2-14	100	56	17
	200	69	48
	300	87	81
2-15	100	61	39
	200	87	73
	300	83	78

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
2-16	100	42	32
	200	35	78
	300	59	85

Surprisingly strong herbicidal effectiveness was observed with compositions 2-10 and 2-11 containing lecithin and Fluorad FC-135 on both ABUTH and ECHCF, by comparison with otherwise similar compositions (2-09 and 2-01) lacking the Fluorad FC-135. Herbicidal effectiveness of composition 2-11 at the 100 g a.e./ha glyphosate rate was superior to that of Formulation C at a threefold higher rate on ABUTH and superior to that of Formulation C at a twofold higher rate on ECHCF.

EXAMPLE 3

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 3a. Process (ii), indicated in Table 3a as involving "high" sonication power, was followed for all compositions, except that for composition 3-06 a different sonication procedure, referred to as "low" sonication power, was used. In this procedure the lecithin in water was sonicated in a Fisher Model FS 14H ultrasonic bath for 30 minutes. Soybean lecithin (10-20% phospholipid, Sigma Type II-S) was used for all compositions. Without adjustment, the pH of the compositions was approximately 5. For those compositions having a pH of approximately 7 as shown in Table 3a, the pH was adjusted using the same base (sodium hydroxide or IPA) that formed the glyphosate salt.

Table 3a

Spray composition	Lecithin g/l	% w/w		Components sonicated with lecithin	pH	Sonication power
		Fluorad FC-135	L-77			
3-01	5.0			none	5	high
3-02	5.0		0.50	none	5	high
3-03	5.0		0.50	L-77	5	high
3-04	5.0		0.50	glyphosate	5	high
3-05	5.0		0.50	L-77, glyphosate	5	high
3-06	5.0			none	7	low
3-07	5.0			none	7	high
3-08	5.0		0.50	none	7	high
3-09	5.0		0.50	L-77	7	high
3-10	5.0		0.50	glyphosate	7	high
3-11	5.0		0.50	L-77, glyphosate	7	high
3-12	5.0	0.50		none	5	high
3-13	5.0	0.50		FC-135	5	high
3-14	5.0	0.50		glyphosate	5	high
3-15	5.0	0.17	0.33	FC-135, glyphosate	5	high
3-16	5.0	0.17	0.33	none	5	high
3-17	5.0	0.17	0.33	FC-135, L-77	5	high
3-18	10.0			none	5	high

Spray composition	Lecithin g/l	% w/w		Components sonicated with lecithin	pH	Sonication power
		Fluorad FC-135	L-77			
3-19	20.0			none	5	high
3-20	10.0		0.50	none	5	high
3-21	10.0		0.50	L-77	5	high
3-22	20.0		0.50	L-77	5	high
3-23	20.0		0.50	L-77, glyphosate	5	high

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 18 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 16 days after application.

Formulations B and C, alone and tank mixed with 0.5% Silwet L-77, were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 3b.

Table 3b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	11	12
	200	55	43
	300	65	38
Formulation B + Silwet L-77 0.5% v/v	100	77	5
	200	95	10
	300	95	17
Formulation C	100	33	42
	200	63	98
	300	85	99
Formulation C + Silwet L-77 0.5% v/v	100	78	7
	200	95	19
	300	98	54
3-01	100	63	22
	200	77	69
	300	92	82
3-02	100	79	30
	200	96	67
	300	98	70
3-03	100	81	29
	200	96	70
	300	97	86
3-04	100	85	32
	200	94	60
	300	98	61
3-05	100	82	34
	200	98	60
	300	96	69

Spray composition	Glyphosate rate g a.e./ha	% Inhibition ABUTH	% Inhibition ECHCF
3-06	100	55	40
	200	91	69
	300	97	90
3-07	100	77	29
	200	93	82
	300	97	100
3-08	100	83	48
	200	95	67
	300	94	74
3-09	100	83	37
	200	95	75
	300	99	83
3-10	100	77	36
	200	99	75
	300	98	69
3-11	100	81	38
	200	94	81
	300	97	76
3-12	100	56	47
	200	91	90
	300	97	95
3-13	100	81	41
	200	94	58
	300	97	84
3-14	100	77	37
	200	94	70
	300	96	94
3-15	100	76	61
	200	95	79
	300	96	85
3-16	100	95	84
	200	94	56
	300	75	32
3-17	100	78	44
	200	93	86
	300	94	87
3-18	100	59	27
	200	94	84
	300	96	100
3-19	100	74	44
	200	94	74
	300	95	95
3-20	100	79	62
	200	89	78
	300	92	93
3-21	100	66	69
	200	80	79
	300	86	88

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
3-22	100	44	69
	200	83	97
	300	74	94
3-23	100	50	71
	200	68	91
	300	85	76

Composition 3-12 containing lecithin and Fluorad FC-135 again showed surprisingly high herbicidal effectiveness by comparison with composition 3-01, lacking the Fluorad FC-135, and also by comparison with Formulation C. When efforts were made to encapsulate Fluorad FC-135 or glyphosate (compositions 3-13 or 3-14 respectively) in lecithin liposomes by sonication in the presence of the ingredients sought to be encapsulated, some further enhancement of herbicidal effectiveness was evident on ABUTH, but effectiveness was reduced on ECHCF. Overall, the best activity in this test was obtained without encapsulation.

EXAMPLE 4

Compositions 3-01 to 3-12 of Example 3 were tested in this Example. Black nightshade (Solanum nigrum, SOLNI) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 26 days after planting SOLNI and evaluation of herbicidal inhibition was done 16 days after application.

Formulations B and C, alone and tank mixed with 0.5% Silwet L-77, were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 4.

Table 4

Spray composition	Glyphosate rate g a.e./ha	% Inhibition SOLNI
Formulation B	100	28
	200	35
	300	70
Formulation B + Silwet L-77 0.5% v/v	100	85
	200	98
	300	97
Formulation C	100	30
	200	58
	300	70
Formulation C + Silwet L-77 0.5% v/v	100	78
	200	82
	300	94
3-01	100	47
	200	77
	300	93

Spray composition	Glyphosate rate g a.e./ha	% Inhibition SOLNI
3-02	100	33
	200	50
	300	78
3-03	100	36
	200	79
	300	90
3-04	100	33
	200	72
	300	84
3-05	100	38
	200	68
	300	82
3-06	100	84
	200	92
	300	96
3-07	100	58
	200	75
	300	85
3-08	100	50
	200	83
	300	91
3-09	100	50
	200	72
	300	83
3-10	100	53
	200	75
	300	78
3-11	100	75
	200	96
	300	100
3-12	100	62
	200	93
	300	99

Composition 3-12 containing lecithin and Fluorad FC-135, as in the test of Example 3, showed remarkably strong herbicidal effectiveness, this time on SOLNI.

EXAMPLE 5

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 5a. Process (ii) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of all compositions was approximately 5.

Table 5a

Spray composition	Lecithin g/l	% w/w Fluorad FC-135	Silwet L-77	KCl	Components sonicated with lecithin
5-01	5.0				glyphosate
5-02	5.0		0.50		L-77
5-03	5.0		0.50		L-77
5-04	5.0		1.00		L-77
5-05	5.0		0.20		none
5-06	5.0		1.00		none
5-07	5.0		0.20		L-77, glyphosate
5-08	5.0		0.50		L-77, glyphosate
5-09	5.0		1.00		L-77, glyphosate
5-10	2.5		0.10		L-77
5-11	2.5		0.25		L-77
5-12	2.5		0.50		L-77
5-13	2.5		0.10		none
5-14	2.5		0.25		none
5-15	2.5		0.10		L-77, glyphosate
5-16	2.5		0.25		L-77, glyphosate
5-17	2.5		0.50		L-77, glyphosate
5-18	5.0		0.50	0.02	L-77
5-19	5.0		0.50	0.02	L-77, glyphosate
5-20	5.0	0.50			none
5-21	5.0	0.50			glyphosate
5-22	5.0	0.33	0.17		none
5-23	5.0	0.33	0.17		glyphosate

Velvetleaf Abutilon theophrasti, ABUTH) and Japanese millet Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 18 days after planting ABUTH and 16 days after planting ECHCF, and evaluation of herbicidal inhibition was done 17 days after application.

Formulations B and C, alone and tank mixed with 0.5% Silwet L-77, were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 5b.

Table 5b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition ABUTH	ECHCF
Formulation B	200	47	83
	300	64	84
	400	71	90
Formulation B + Silwet L-77 0.5% v/v	200	83	58
	300	94	76
	400	100	85
Formulation C	200	46	96
	300	68	90
	400	75	93

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation C + Silwet L-77 0.5% v/v	200	81	66
	300	93	68
	400	96	86
5-01	200	70	91
	300	74	100
	400	93	94
5-02	200	81	95
	300	68	100
	400	81	100
5-03	200	78	100
	300	99	83
	400	98	99
5-04	200	89	95
	300	93	95
	400	86	100
5-05	200	60	89
	300	79	100
	400	86	100
5-06	200	76	100
	300	84	100
	400	100	96
5-07	200	65	97
	300	78	97
	400	77	100
5-08	200	82	100
	300	95	100
	400	96	100
5-09	200	78	99
	300	89	99
	400	90	100
5-10	200	66	100
	300	79	98
	400	89	100
5-11	200	67	95
	300	81	100
	400	97	100
5-12	200	76	88
	300	79	100
	400	95	96
5-13	200	59	85
	300	66	93
	400	67	100
5-14	200	56	89
	300	67	100
	400	83	100
5-15	200	54	100
	300	63	100
	400	78	100

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
5-16	200	46	88
	300	73	100
	400	86	100
5-17	200	81	98
	300	83	97
	400	92	96
5-18	200	56	92
	300	64	100
	400	74	100
5-19	200	64	94
	300	80	97
	400	80	96
5-20	200	88	91
	300	96	100
	400	98	98
5-21	200	92	94
	300	100	100
	400	100	100
5-22	200	88	97
	300	93	95
	400	95	100
5-23	200	79	100
	300	96	100
	400	97	96

Glyphosate activity on ECHCF in this test was too high to make meaningful comparisons. However, on ABUTH, composition 5-20 containing lecithin and Fluorad FC-135 exhibited remarkably strong herbicidal effectiveness by comparison with composition 5-01 (no Fluorad FC-135) and Formulation C. As in previous testing, a slight further advantage on ABUTH was obtained by efforts to encapsulate the glyphosate in lecithin liposomes, as in composition 5-21. Compositions 5-22 and 5-23, containing both Fluorad FC-135 and Silwet L-77 in addition to lecithin, also showed remarkably good herbicidal effectiveness.

EXAMPLE 6

Compositions 5-01 to 5-23 of Example 5 were tested in this Example. Morningglory (Ipomoea spp., IPOSS) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting IPOSS and evaluation of herbicidal inhibition was done 19 days after application.

Formulations B and C, alone and tank mixed with 0.5% Silwet L-77, were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 6.

Table 6

Spray composition	Glyphosate rate g a.e./ha	% Inhibition IPOSS
Formulation B	200	40
	400	66
Formulation B + Silwet L-77 0.5% v/v	200	68
	400	79
Formulation C	200	62
	400	71
Formulation C + Silwet L-77 0.5% v/v	200	70
	400	72
5-01	200	64
	400	77
5-02	200	68
	400	75
5-03	200	68
	400	72
5-04	200	69
	400	72
5-05	200	64
	400	78
5-06	200	80
	400	89
5-07	200	69
	400	74
5-08	200	60
	400	72
5-09	200	79
	400	84
5-10	200	69
	400	78
5-11	200	52
	400	72
5-12	200	69
	400	88
5-13	200	72
	400	74
5-14	200	68
	400	69
5-15	200	68
	400	70
5-16	200	55
	400	69
5-17	200	52
	400	67
5-18	200	65
	400	67
5-19	200	54
	400	70

Spray composition	Glyphosate rate g a.e./ha	% Inhibition
		IPOSS
5-20	200	74
	400	100
5-21	200	72
	400	91
5-22	200	81
	400	84
5-23	200	79
	400	90

Once again, surprisingly strong herbicidal effectiveness, this time on IPOSS, was exhibited by compositions 5-20 to 5-23, all of which contain lecithin and Fluorad FC-135.

EXAMPLE 7

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 7a. Process (ii) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of all compositions was adjusted to approximately 7.

Table 7a

Spray composition	Lecithin g/l	% w/w		Components sonicated with lecithin
		Fluorad FC-135	Silwet L-77	
7-01	5.0		0.50	L-77
7-02	5.0		0.25	L-77
7-03	5.0		0.10	L-77
7-04	5.0			none
7-05	2.5		0.50	L-77
7-06	2.5		0.25	L-77
7-07	2.5		0.10	L-77
7-08	1.0		0.50	L-77
7-09	1.0		0.25	L-77
7-10	2.5		0.10	L-77
7-11	2.5	0.25	0.25	L-77
7-12	2.5	0.17	0.33	L-77
7-13	2.5	0.33	0.17	L-77
7-14	2.5	0.50		none
7-15	2.5	0.25		none
7-16	2.5	0.10		none
7-17	2.5		0.25	glyphosate
7-18	2.5		0.10	glyphosate
7-19	2.5		0.50	glyphosate
7-20	5.0		0.50	L-77, glyphosate
7-21	2.5		0.25	L-77, glyphosate
7-22	1.0		0.25	L-77, glyphosate
7-23	1.0		0.10	L-77, glyphosate

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF), and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 20 days after planting ABUTH and ECHCF. Planting date for SIDSP was not recorded. Evaluation of herbicidal inhibition was done 19 days after application.

Formulations B and C, alone and tank mixed with 0.5% Silwet L-77, were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 7b.

Table 7b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Formulation B	150	33	39	29
	250	44	43	66
	350	83	45	60
Formulation B + Silwet L-77 0.5% v/v	150	81	7	46
	250	88	21	64
	350	96	32	66
Formulation C	150	61	59	58
	250	77	92	85
	350	91	92	83
Formulation C + Silwet L-77 0.5% v/v	150	76	10	65
	250	87	17	60
	350	92	39	64
7-01	150	87	43	47
	250	88	41	60
	350	96	53	66
7-02	150	66	51	61
	250	85	81	63
	350	84	89	75
7-03	150	66	54	65
	250	70	63	60
	350	94	96	87
7-04	150	73	58	61
	250	85	83	90
	350	91	100	83
7-05	150	76	44	49
	250	85	55	56
	350	93	79	64
7-06	150	64	73	56
	250	71	78	61
	350	81	79	77
7-07	150	53	41	59
	250	74	78	68
	350	78	90	75
7-08	150	83	33	59
	250	82	39	75
	350	95	59	69

Spray composition	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
7-09	150	78	32	46
	250	85	42	75
	350	91	62	67
7-10	150	26	36	43
	250	69	73	75
	350	76	81	73
7-11	150	83	79	72
	250	96	93	78
	350	99	97	84
7-12	150	78	57	58
	250	89	78	66
	350	94	93	75
7-13	150	83	84	54
	250	94	93	67
	350	99	97	93
7-14	150	80	68	69
	250	85	88	79
	350	97	94	99
7-15	150	75	80	62
	250	93	93	76
	350	95	91	94
7-16	150	75	69	60
	250	88	91	77
	350	89	92	75
7-17	150	77	69	67
	250	88	91	86
	350	93	97	96
7-18	150	71	63	66
	250	74	85	82
	350	89	85	83
7-19	150	74	62	77
	250	86	80	93
	350	92	96	96
7-20	150	39	46	38
	250	80	49	69
	350	91	64	69
7-21	150	65	50	34
	250	64	52	52
	350	78	67	62
7-22	150	68	18	35
	250	79	42	43
	350	87	49	58
7-23	150	24	46	38
	250	62	49	42
	350	91	53	67

Compositions 7-14 to 7-16, containing 0.25% lecithin together with Fluorad FC-135, provided excellent herbicidal effectiveness on all three species tested. Even at the lowest concentration of Fluorad FC-135 (0.1% in composition 7-16), effectiveness was substantially maintained on ABUTH and ECHCF, although some loss of effectiveness was evident on SIDSP. Compositions 7-11 to 7-13, containing lecithin, Fluorad FC-135 and Silwet L-77, also performed well in this test, not showing the antagonism on ECHCF characteristic of compositions containing Silwet L-77 but no Fluorad FC-135.

EXAMPLE 8

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 8a. Process (ii) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti).

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 8a. The pH of all compositions was adjusted to approximately 7.

Table 8a

Spray composition	Lecithin g/l	% w/w		Components sonicated with lecithin
		Fluorad FC-135	Silwet L-77	
8-01	5.0		0.50	L-77
8-02	5.0		0.25	L-77
8-03	5.0		0.10	L-77
8-04	5.0			none
8-05	2.5		0.50	L-77
8-06	2.5		0.25	L-77
8-07	2.5		0.10	L-77
8-08	1.0		0.50	L-77
8-09	1.0		0.25	L-77
8-10	2.5		0.10	L-77
8-11	2.5	0.25	0.25	L-77
8-12	2.5	0.17	0.33	L-77
8-13	2.5	0.33	0.17	L-77
8-14	2.5	0.50		none
8-15	2.5	0.25		none
8-16	2.5	0.10		none
8-17	2.5		0.25	glyphosate
8-18	2.5		0.10	glyphosate
8-19	2.5		0.50	glyphosate

Yellow nutsedge (Cyperus esculentus, CYPES) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 21 days after planting CYPES, and evaluation of herbicidal inhibition was done 27 days after application.

Formulations B and C, alone and tank mixed with 0.5% Silwet L-77, were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 8b.

Table 8b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition CYPES
Formulation B	500	92
	1000	95
	5000	100
Formulation B + Silwet L-77 0.5% v/v	500	100
	1000	87
	5000	100
Formulation C	500	87
	1000	96
	5000	100
Formulation C + Silwet L-77 0.5% v/v	500	98
	1000	94
	5000	100
8-01	500	91
	1000	100
	1500	97
8-02	500	83
	1000	100
	1500	100
8-03	500	90
	1000	88
	1500	71
8-04	500	88
	1000	100
	1500	100
8-05	500	84
	1000	99
	1500	95
8-06	500	90
	1000	88
	1500	99
8-07	500	78
	1000	94
	1500	97
8-08	500	93
	1000	96
	1500	100
8-09	500	87
	1000	88
	1500	100
8-10	500	86
	1000	100
	1500	100
8-11	500	95
	1000	94
	1500	100

Spray composition	Glyphosate rate g a.e./ha	% Inhibition
		CYPES
8-12	500	92
	1000	92
	1500	100
8-13	500	87
	1000	97
	1500	100
8-14	500	82
	1000	100
	1500	100
8-15	500	85
	1000	90
	1500	95
8-16	500	87
	1000	91
	1500	100
8-17	500	83
	1000	90
	1500	95
8-18	500	93
	1000	100
	1500	95
8-19	500	86
	1000	95
	1500	100

The commercial standard Formulation C exhibited very high herbicidal effectiveness in this test and for this reason it is not possible to discern enhancements. There is a suggestion at the lowest glyphosate rate (500 g a.e./ha), effectiveness of compositions containing lecithin and Fluorad FC-135 (8-14 to 8-16) on CYPES surprisingly improved with decreasing Fluorad FC-135 concentration.

EXAMPLE 9

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 9a. Process (ii) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of all compositions was adjusted to approximately 7.

Table 9a

Spray composition	Lecithin g/l	% w/w		Components sonicated with lecithin
		Fluorad FC-135	Silwet L-77	
9-01	5.0			none
9-02	5.0		0.50	none
9-03	5.0		0.50	L-77
9-04	2.5			none
9-05	2.5		0.50	none
9-06	2.5		0.50	L-77
9-07	1.0			none

Spray composition	Lecithin g/l	% w/w		Components sonicated with lecithin
		Fluorad FC-135	Silwet L-77	
9-08	1.0		0.50	none
9-09	1.0		0.50	L-77
9-10	0.5			none
9-11	0.5		0.50	none
9-12	0.5		0.50	L-77
9-13	1.0		0.25	none
9-14	1.0		0.25	L-77
9-15	1.0		0.10	none
9-16	1.0		0.10	L-77
9-17	1.0	0.50		none
9-18	1.0	0.20		none
9-19	1.0	0.10		none
9-20	0.5	0.50		none
9-21	0.5	0.20		none

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. There was no record of the dates of planting. Evaluation of herbicidal inhibition was done 16 days after application.

In addition to compositions 9-01 to 9-21, spray compositions were prepared by tank mixing Formulations B and C with 0.5% Fluorad FC-135. Formulations B and C, alone and tank mixed with 0.5% Silwet L-77, were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 9b.

Table 9b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	64	77
	250	81	80
	350	88	97
Formulation B + Silwet L-77 0.5% v/v	150	42	38
	250	56	49
	350	67	64
Formulation C	150	61	89
	250	75	91
	350	92	99
Formulation C + Silwet L-77 0.5% v/v	150	92	40
	250	95	40
	350	94	74
Formulation B + Fluorad FC-135 0.5% w/v	150	87	34
	250	90	44
	350	97	47
Formulation C + Fluorad FC-135 0.5% w/v	150	79	85
	250	77	86
	350	92	91

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
9-01	150	75	69
	250	84	89
	350	98	98
9-02	150	86	54
	250	96	74
	350	99	86
9-03	150	86	66
	250	91	77
	350	96	86
9-04	150	68	73
	250	97	85
	350	94	92
9-05	150	90	55
	250	96	69
	350	91	82
9-06	150	87	43
	250	91	68
	350	97	83
9-07	150	56	76
	250	81	88
	350	89	96
9-08	150	85	35
	250	93	51
	350	98	66
9-09	150	94	45
	250	97	47
	350	98	52
9-10	150	62	60
	250	85	78
	350	93	88
9-11	150	90	32
	250	92	42
	350	98	59
9-12	150	93	38
	250	93	56
	350	95	72
9-13	150	85	39
	250	89	66
	350	94	79
9-14	150	83	70
	250	93	45
	350	93	70
9-15	150	65	54
	250	85	79
	350	91	89
9-16	150	75	65
	250	83	79
	350	90	84

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
9-17	150	81	94
	250	88	97
	350	100	99
9-18	150	79	89
	250	95	91
	350	98	98
9-19	150	77	85
	250	91	96
	350	95	97
9-20	150	77	71
	250	86	92
	350	100	93
9-21	150	75	91
	250	84	97
	350	96	95

Compositions of this Example (9-17 to 9-21) containing very low concentrations of lecithin and Fluorad FC-135 exhibited remarkably high herbicidal effectiveness. Even a composition (9-19) with just 0.1% lecithin and 0.1% Fluorad FC-135 was much more effective on ABUTH than commercial standard Formulation C, and equally as effective on ECHCF as Formulation C. The apparently strong antagonism on ECHCF seen when Formulation B was tank mixed with 0.5% Fluorad FC-135 in this test is uncharacteristic and has not been seen in other tests (see, for example, Example 12 herein); indeed the data for this set of treatments is so out of line that it is believed they may be due to an error in application.

EXAMPLE 10

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 10a. Process (iii) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of all compositions was adjusted to approximately 7.

Table 10a

Spray composition	Lecithin g/l	% w/w				Components sonicated with lecithin
		Fluorad FC-135	Silwet L-77	Methyl caprate	Sodium cholate	
10-01	5.0					none
10-02	5.0		0.50			none
10-03	5.0		0.50			L-77
10-04	2.5					none
10-05	0.5					none
10-06	2.5		0.50			none
10-07	2.5		0.50			L-77
10-08	0.5		0.50			none
10-09	0.5		0.50			L-77
10-10	2.5	0.25				none

Spray composition	Lecithin g/l	% w/w				Components sonicated with lecithin
		Fluorad FC-135	Silwet L-77	Methyl caprate	Sodium cholate	
10-11	2.5	0.10				none
10-12	2.5	0.05				none
10-13	0.5	0.25				none
10-14	0.5	0.10				none
10-15	0.5	0.05				none
10-16	2.5			0.10		Me caprate
10-17	2.5				0.10	Na cholate

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 18 days after planting ABUTH and 21 days after planting ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

In addition to compositions 10-01 to 10-17, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 at various concentrations. Formulations B and C, alone and tank mixed with 0.5% Silwet L-77, were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 10b.

Table 10b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	200	53	69
	300	76	85
	400	77	81
Formulation B + Silwet L-77 0.5% v/v	200	100	28
	300	100	35
	400	100	47
Formulation C	200	57	81
	300	73	90
	400	98	94
Formulation C + Silwet L-77 0.5% v/v	200	99	28
	300	98	53
	400	99	56
Formulation B + Fluorad FC-135 0.25% w/v	200	76	85
	300	95	81
	400	100	100
Formulation B + Fluorad FC-135 0.1% w/v	200	77	70
	300	94	81
	400	98	87
Formulation B + Fluorad FC-135 0.05% w/v	200	65	73
	300	84	94
	400	88	96
Formulation C + Fluorad FC-135 0.25% w/v	200	83	78
	300	98	94
	400	97	95

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation C + Fluorad FC-135 0.1% w/v	200	65	66
	300	89	86
	400	97	89
Formulation C + Fluorad FC-135 0.05% w/v	200	70	78
	300	79	84
	400	96	98
10-01	200	93	71
	300	91	89
	400	97	97
10-02	200	95	59
	300	97	68
	400	99	79
10-03	200	97	55
	300	98	62
	400	100	76
10-04	200	83	72
	300	87	84
	400	95	100
10-05	200	69	78
	300	92	93
	400	98	97
10-06	200	94	61
	300	99	67
	400	100	76
10-07	200	99	52
	300	99	63
	400	100	80
10-08	200	96	47
	300	99	57
	400	99	55
10-09	200	99	23
	300	98	58
	400	100	53
10-10	200	89	91
	300	91	99
	400	98	100
10-11	200	81	91
	300	91	99
	400	92	100
10-12	200	66	96
	300	86	100
	400	94	99
10-13	200	80	97
	300	98	98
	400	99	100
10-14	200	68	92
	300	89	100
	400	99	98

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
10-15	200	84	95
	300	94	100
	400	97	100
10-16	200	73	94
	300	89	100
	400	99	100
10-17	200	58	94
	300	77	96
	400	90	90

Tank mixture of Fluorad FC-135 at concentrations as low as 0.05% with Formulation B resulted in remarkably strong herbicidal efficacy in this test. The antagonism on ECHCF seen with the nonionic organosilicone surfactant Silwet L-77 did not occur with the cationic fluoro-organic surfactant Fluorad FC-135. Noteworthy was the outstanding herbicidal effectiveness provided by a composition (10-15) containing just 0.05% lecithin and 0.05% Fluorad FC-135. In this test addition of 0.1% methyl caprate to 0.25% lecithin, the methyl caprate being sonicated together with the lecithin, enhanced performance on ECHCF but not on ABUTH (compare compositions 10-16 and 10-04).

EXAMPLE 11

Compositions 10-01 to 10-17 of Example 10, and tank mixtures of Formulations B and C with Fluorad FC-135, were tested in this Example. Prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 22 days after planting SIDSP, and evaluation of herbicidal inhibition was done 19 days after application.

Formulations B and C, alone and tank mixed with 0.5% Silwet L-77, were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 11.

Table 11

Spray composition	Glyphosate rate g a.e./ha	% Inhibition SIDSP
Formulation B	200	46
	300	75
	400	80
Formulation B + Silwet L-77 0.5% v/v	200	96
	300	89
	400	87
Formulation C	200	80
	300	98
	400	98
Formulation C + Silwet L-77 0.5% v/v	200	75
	300	91
	400	94

Spray composition	Glyphosate rate g a.e./ha	% Inhibition SIDSP
Formulation B + Fluorad FC-135 0.25% w/v	200	82
	300	94
	400	98
Formulation B + Fluorad FC-135 0.1% w/v	200	70
	300	93
	400	88
Formulation B + Fluorad FC-135 0.05% w/v	200	79
	300	92
	400	99
Formulation C + Fluorad FC-135 0.25% w/v	200	79
	300	97
	400	97
Formulation C + Fluorad FC-135 0.1% w/v	200	90
	300	96
	400	97
Formulation C + Fluorad FC-135 0.05% w/v	200	80
	300	96
	400	99
10-01	200	93
	300	97
	400	98
10-02	200	71
	300	89
	400	89
10-03	200	71
	300	87
	400	98
10-04	200	76
	300	100
	400	100
10-05	200	91
	300	99
	400	97
10-06	200	57
	300	95
	400	88
10-07	200	64
	300	68
	400	94
10-08	200	89
	300	96
	400	99
10-09	200	80
	300	77
	400	94
10-10	200	90
	300	94
	400	98

Spray composition	Glyphosate rate g a.e./ha	% Inhibition SIDSP
10-11	200	81
	300	100
	400	96
10-12	200	86
	300	92
	400	95
10-13	200	86
	300	99
	400	100
10-14	200	97
	300	100
	400	100
10-15	200	99
	300	100
	400	100
10-16	200	92
	300	100
	400	100
10-17	200	92
	300	99
	400	100

Herbicidal effectiveness of Formulation C was very high on SIDSP in this test and accordingly enhancements are difficult to discern. However, remarkably strong performance was again seen with composition 10-15, containing just 0.05% lecithin and 0.05% Fluorad FC-135.

EXAMPLE 12

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 12a. Process (iii) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of all compositions was adjusted to approximately 7.

Table 12a

Spray comp.	Lecithin g/l	% w/w Fluorad FC-135	% w/w Silwet L-77	% w/w Other (*)	(*) Other ingredient	Components sonicated with lecithin
12-01	5.0					none
12-02	5.0		0.50			L-77
12-03	2.5					none
12-04	2.5	0.50				none
12-05	2.5	0.20				none
12-06	2.5	0.10				none
12-07	5.0			0.50	Diacid 1550	Diacid
12-08	5.0			0.10	Diacid 1550	Diacid
12-09	2.5			0.25	Diacid 1550	Diacid
12-10	2.5	0.25		0.05	Diacid 1550	Diacid
12-11	5.0	0.10		0.50	Genapol UD-030	Genapol

Spray comp.	Lecithin g/l	% w/w			(*) Other ingredient	Components sonicated with lecithin
		Fluorad FC-135	Silwet L-77	Other (*)		
12-12	5.0	0.05		0.20	Genapol UD-030	Genapol
12-13	5.0	0.25		0.50	Neodol 25-3	Neodol
12-14	5.0	0.10		0.20	Neodol 25-3	Neodol

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and morningglory (Ipomoea spp., IPOSS) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH, 18 days after planting ECHCF and 9 days after planting IPOSS. Evaluation of herbicidal inhibition was done 15 days after application.

In addition to compositions 12-01 to 12-14, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 at various concentrations. Formulations B and C, alone and tank mixed with 0.5% Silwet L-77, were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 12b.

Table 12b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	IPOSS
Formulation B	200	24	53	33
	300	47	37	37
	400	64	46	64
Formulation B + Silwet L-77 0.5% v/v	200	85	3	66
	300	97	19	77
	400	98	18	82
Formulation C	200	39	69	38
	300	71	90	67
	400	87	100	76
Formulation C + Silwet L-77 0.5% v/v	200	90	8	72
	300	95	50	79
	400	100	90	73
Formulation B + Fluorad FC-135 0.5% w/v	200	75	71	65
	300	94	92	79
	400	98	100	77
Formulation B + Fluorad FC-135 0.25% w/v	200	75	67	67
	300	85	73	71
	400	96	97	75
Formulation B + Fluorad FC-135 0.1% w/v	200	61	53	48
	300	82	98	72
	400	95	86	70
Formulation C + Fluorad FC-135 0.5% w/v	200	81	61	69
	300	75	75	71
	400	84	84	77

Spray composition	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	IPOSS
Formulation C + Fluorad FC-135 0.25% w/v	200	35	58	67
	300	68	97	64
	400	92	96	73
Formulation C + Fluorad FC-135 0.1% w/v	200	40	84	51
	300	79	94	58
	400	99	86	74
12-01	200	69	69	62
	300	82	82	73
	400	88	84	77
12-02	200	81	75	67
	300	83	74	72
	400	95	93	75
12-03	200	48	69	70
	300	82	93	71
	400	94	100	72
12-04	200	68	78	64
	300	90	94	76
	400	96	99	79
12-05	200	75	86	68
	300	86	95	72
	400	96	89	80
12-06	200	80	95	57
	300	85	82	60
	400	96	91	73
12-07	200	41	72	64
	300	76	82	68
	400	80	98	77
12-08	200	40	71	70
	300	51	91	76
	400	77	98	72
12-09	200	43	74	64
	300	58	95	76
	400	73	100	77
12-10	200	43	85	65
	300	74	75	65
	400	83	99	76
12-11	200	39	71	66
	300	61	88	71
	400	89	99	73
12-12	200	54	57	59
	300	79	77	75
	400	89	84	71
12-13	200	69	72	69
	300	59	66	69
	400	86	81	76
12-14	200	54	62	65
	300	65	77	69
	400	84	81	74

Tank mixtures of Formulation B with Fluorad FC-135 gave greater herbicidal effectiveness than Formulation C alone, without the attendant antagonism on ECHCF so characteristic of Silwet L-77. Addition of Fluorad FC-135 to glyphosate compositions containing 0.25% lecithin enhanced herbicidal effectiveness on ABUTH and ECHCF, but not, in this test, on IPOSS (compare compositions 12-04 to 12-06 with composition 12-03).

EXAMPLE 13

Compositions 12-01 to 12-14 of Example 12, and tank mixtures of Formulations B and C with Fluorad FC-135, were tested in this Example. Prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 23 days after planting SIDSP, and evaluation of herbicidal inhibition was done 19 days after application.

Formulations B and C, alone and tank mixed with 0.5% Silwet L-77, were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 13.

Table 13

Spray composition	Glyphosate rate g a.e./ha	% Inhibition SIDSP
Formulation B	200	37
	300	47
	400	50
Formulation B + Silwet L-77 0.5% v/v	200	93
	300	100
	400	99
Formulation C	200	47
	300	63
	400	86
Formulation C + Silwet L-77 0.5% v/v	200	88
	300	92
	400	99
Formulation B + Fluorad FC-135 0.5% w/v	200	51
	300	79
	400	84
Formulation B + Fluorad FC-135 0.25% w/v	200	49
	300	53
	400	85
Formulation B + Fluorad FC-135 0.1% w/v	200	44
	300	58
	400	70
Formulation C + Fluorad FC-135 0.5% w/v	200	74
	300	89
	400	97
Formulation C + Fluorad FC-135 0.25% w/v	200	52
	300	70
	400	75

Spray composition	Glyphosate rate g a.e./ha	% Inhibition SIDSP
Formulation C + Fluorad FC-135 0.1% w/v	200	45
	300	74
	400	87
12-01	200	62
	300	76
	400	89
12-02	200	59
	300	54
	400	73
12-03	200	56
	300	89
	400	80
12-04	200	72
	300	89
	400	96
12-05	200	66
	300	87
	400	84
12-06	200	60
	300	74
	400	86
12-07	200	57
	300	78
	400	89
12-08	200	59
	300	67
	400	70
12-09	200	57
	300	65
	400	74
12-10	200	53
	300	77
	400	77
12-11	200	58
	300	71
	400	87
12-12	200	54
	300	70
	400	82
12-13	200	65
	300	75
	400	82
12-14	200	61
	300	77
	400	81

On SIDSP in this test, tank mix addition of Fluorad FC-135 to Formulation B enhanced herbicidal effectiveness over that obtained with Formulation C alone, only at the 0.5% concentration of Fluorad FC-135. Likewise, when added to a glyphosate composition containing 0.25% lecithin, Fluorad FC-135 enhanced herbicidal effectiveness most significantly at the 0.5% concentration (composition 12-04).

EXAMPLE 14

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 14a. Process (iii) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The following compositions had a pH of approximately 5: 14-01, 14-03, 14-07, 14-08, 14-10 and 14-12 to 14-17. All others were adjusted to a pH of approximately 7.

Table 14a

Spray composition	Lecithin g/l	% w/w			Components sonicated with lecithin
		Fluorad FC-135	Silwet L-77	Diacid 1550	
14-01	5.0				none
14-02	5.0				none
14-03	2.5				none
14-04	2.5				none
14-05	5.0				glyphosate
14-06	5.0		0.50		L-77
14-07	5.0		0.50		L-77
14-08	2.5		0.50		L-77
14-09	2.5		0.50		L-77
14-10	2.5		0.25		glyphosate
14-11	2.5		0.25		glyphosate
14-12	2.5	0.25			none
14-13	2.5	0.25			glyphosate
14-14	2.5	0.10			none
14-15	2.5	0.10			glyphosate
14-16	2.5		0.25	0.25	L-77, Diacid
14-17	2.5		0.10	0.05	L-77, Diacid

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and 20 days after planting ECHCF, and evaluation of herbicidal inhibition was done 20 days after application.

In addition to compositions 14-01 to 14-17, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 at two concentrations. Formulations B and C, alone and tank mixed with 0.5% and 0.25% Silwet L-77, were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 14b.

Table 14b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	200	53	43
	300	73	50
	400	91	74
Formulation B + Silwet L-77 0.5% v/v	200	86	24
	300	88	15
	400	94	58
Formulation B + Silwet L-77 0.25% w/v	200	80	22
	300	93	38
	400	87	38
Formulation C	200	56	88
	300	86	98
	400	94	98
Formulation C + Silwet L-77 0.5% v/v	200	87	23
	300	93	52
	400	91	60
Formulation C + Silwet L-77 0.25% v/v	200	79	42
	300	83	73
	400	87	95
Formulation B + Fluorad FC-135 0.25% w/v	200	79	49
	300	89	77
	400	94	85
Formulation B + Fluorad FC-135 0.1% w/v	200	73	64
	300	89	68
	400	92	75
Formulation C + Fluorad FC-135 0.25% w/v	200	73	86
	300	75	90
	400	90	95
Formulation C + Fluorad FC-135 0.1% w/v	200	53	97
	300	89	96
	400	91	99
14-01	200	71	66
	300	89	62
	400	97	85
14-02	200	83	52
	300	89	72
	400	82	93
14-03	200	54	53
	300	89	84
	400	93	77
14-04	200	81	38
	300	94	76
	400	98	88
14-05	200	85	53
	300	95	80
	400	94	91

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
14-06	200	80	0
	300	95	100
	400	98	94
14-07	200	72	50
	300	95	84
	400	98	92
14-08	200	81	69
	300	99	83
	400	100	80
14-09	200	86	38
	300	94	80
	400	96	90
14-10	200	58	67
	300	82	85
	400	92	90
14-11	200	83	64
	300	88	74
	400	90	88
14-12	200	89	90
	300	100	88
	400	100	98
14-13	200	95	91
	300	93	97
	400	100	98
14-14	200	88	93
	300	93	85
	400	98	90
14-15	200	85	87
	300	98	98
	400	96	100
14-16	200	76	72
	300	83	87
	400	89	97
14-17	200	53	67
	300	48	62
	400	82	85

Compositions 14-12 to 14-15, containing 0.25% lecithin together with Fluorad FC-135, exhibited much greater herbicidal effectiveness on both ABUTH and ECHCF than composition 14-03, containing 0.25% lecithin but no Fluorad FC-135, or even composition 14-01, containing 0.5% lecithin but no Fluorad FC-135. No great or consistent difference was seen between compositions where glyphosate had been sonicated together with the lecithin (14-13 and 14-15) than where the lecithin had been sonicated alone (14-12 and 14-14).

EXAMPLE 15

Compositions 14-01 to 14-17 of Example 14, and tank mixtures of Formulations B and C with Fluorad FC-135, were tested in this Example. Prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 22 days after planting SIDSP, and evaluation of herbicidal inhibition was done 19 days after application.

Formulations B and C, alone and tank mixed with 0.5% and 0.25% Silwet L-77, were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 15.

Table 15

Spray composition	Glyphosate rate g a.e./ha	% Inhibition SIDSP
Formulation B	200	23
	300	37
	400	32
Formulation B + Silwet L-77 0.5% v/v	200	30
	300	39
	400	45
Formulation B + Silwet L-77 0.25% w/v	200	28
	300	49
	400	28
Formulation C	200	41
	300	54
	400	84
Formulation C + Silwet L-77 0.5% v/v	200	43
	300	66
	400	86
Formulation C + Silwet L-77 0.25% v/v	200	17
	300	35
	400	58
Formulation B + Fluorad FC-135 0.25% w/v	200	48
	300	60
	400	62
Formulation B + Fluorad FC-135 0.1% w/v	200	31
	300	47
	400	75
Formulation C + Fluorad FC-135 0.25% w/v	200	43
	300	57
	400	71
Formulation C + Fluorad FC-135 0.1% w/v	200	32
	300	71
	400	63
14-01	200	51
	300	55
	400	76
14-02	200	51
	300	68
	400	84

Spray composition	Glyphosate rate g a.e./ha	% Inhibition SIDSP
14-03	200	55
	300	51
	400	72
14-04	200	50
	300	64
	400	75
14-05	200	46
	300	53
	400	61
14-06	200	40
	300	44
	400	73
14-07	200	23
	300	32
	400	39
14-08	200	18
	300	44
	400	57
14-09	200	25
	300	30
	400	43
14-10	200	19
	300	36
	400	38
14-11	200	35
	300	48
	400	57
14-12	200	65
	300	80
	400	88
14-13	200	68
	300	75
	400	87
14-14	200	76
	300	76
	400	72
14-15	200	54
	300	73
	400	84
14-16	200	44
	300	51
	400	63
14-17	200	23
	300	45
	400	57

Compositions 14-12 to 14-15, containing 0.25% lecithin together with Fluorad FC-135, exhibited greater herbicidal effectiveness on SIDSP than composition 14-03, containing 0.25% lecithin but no Fluorad FC-135, or even composition 14-01, containing 0.5% lecithin but no Fluorad FC-135. No great or consistent difference was seen between compositions where glyphosate had been sonicated together with the lecithin (14-13 and 14-15) than where the lecithin had been sonicated alone (14-12 and 14-14).

EXAMPLE 16

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 16a. Process (iii) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of all compositions was adjusted to approximately 7.

Table 16a

Spray comp.	Lecithin g/l	% w/w		(*) Other ingredient	Components sonicated with lecithin
		Fluorad FC-135	Other (*)		
16-01	2.5				none
16-02	2.5				glyphosate
16-03	2.5	0.25			none
16-04	2.5	0.25			glyphosate
16-05	2.5		0.25	Silwet 800	none
16-06	2.5		0.25	Silwet 800	Silwet 800
16-07	2.5		0.25	Silwet 800	Silwet, glyphosate
16-08	0.5				none
16-09	0.5				glyphosate
16-10	0.5	0.05			none
16-11	0.5	0.05			glyphosate
16-12	0.5	0.03	0.02	Silwet L-77	Silwet L-77
16-13	0.5		0.05	methyl caprate	Me caprate
16-14	0.5	0.05	0.05	methyl caprate	Me caprate
16-15	0.5	0.05	0.05	methyl caprate	Me caprate, glyphosate
16-16	0.5		0.01	PVA	none
16-17	0.5		0.01	PVA	glyphosate
16-18	0.5	0.05	0.01	PVA	glyphosate
16-19	0.5		0.05 + 0.01	L-77 + PVA	Silwet L-77

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 19 days after planting ABUTH and 21 days after planting ECHCF, and evaluation of herbicidal inhibition was done 17 days after application.

In addition to compositions 16-01 to 16-19, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 at two concentrations. Formulations B and C, alone and tank mixed with 0.5% Silwet 800, were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 16b.

Table 16b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition ABUTH	% Inhibition ECHCF
Formulation B	150	13	28
	250	37	51
	350	56	38
Formulation B + Silwet 800 0.25% v/v	150	81	15
	250	89	17
	350	91	20
Formulation C	150	32	65
	250	59	91
	350	85	89
Formulation C + Silwet 800 0.25% v/v	150	91	17
	250	91	23
	350	95	48
Formulation B + Fluorad FC-135 0.25% w/v	150	31	58
	250	53	68
	350	71	84
Formulation B + Fluorad FC-135 0.05% w/v	150	31	29
	250	44	69
	350	95	79
Formulation C + Fluorad FC-135 0.25% w/v	150	46	45
	250	69	79
	350	86	77
Formulation C + Fluorad FC-135 0.05% w/v	150	44	57
	250	60	87
	350	86	88
16-01	150	55	50
	250	87	81
	350	89	88
16-02	150	56	54
	250	89	69
	350	87	98
16-03	150	89	68
	250	89	84
	350	91	90
16-04	150	63	68
	250	89	86
	350	99	89
16-05	150	81	51
	250	87	84
	350	94	26
16-06	150	67	0
	250	93	62
	350	94	81
16-07	150	81	35
	250	84	51
	350	95	62

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
16-08	150	59	51
	250	84	69
	350	98	90
16-09	150	64	59
	250	85	61
	350	94	96
16-10	150	73	74
	250	87	83
	350	98	96
16-11	150	76	64
	250	88	79
	350	94	81
16-12	150	59	46
	250	82	88
	350	92	82
16-13	150	61	45
	250	90	69
	350	93	90
16-14	150	76	50
	250	95	73
	350	99	91
16-15	150	78	67
	250	95	80
	350	99	85
16-16	150	48	42
	250	77	87
	350	87	75
16-17	150	47	63
	250	85	67
	350	90	78
16-18	150	55	46
	250	82	77
	350	90	87
16-19	150	32	23
	250	43	31
	350	76	65

As in Example 10, glyphosate compositions (16-10 and 16-11) containing just 0.05% lecithin and 0.05% Fluorad FC-135 exhibited surprisingly great herbicidal efficacy in this test. Sonicating the lecithin in the presence of glyphosate in an effort to encapsulate some of the glyphosate (composition 16-11) did not give an advantage in performance over sonicating the lecithin alone (composition 16-10); indeed on ECHCF herbicidal efficacy was slightly better without such efforts to encapsulate the glyphosate. Addition of methyl caprate to compositions containing lecithin with or without Fluorad FC-135 (16-13 to 16-15) improved herbicidal effectiveness on ABUTH but had little effect on ECHCF.

EXAMPLE 17

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 17a. Process (iii) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of all compositions was adjusted to approximately 7.

Table 17a

Spray composition	Lecithin g/l	% w/w		(*) Other ingredient	Components sonicated with lecithin
		Fluorad FC-135	Other (*)		
17-01	2.5				none
17-02	2.5	0.25			none
17-03	2.5	0.25			glyphosate
17-04	2.5	0.25	0.025	PVA	none
17-05	1.0				none
17-06	1.0				glyphosate
17-07	1.0	0.10			none
17-08	1.0	0.10			glyphosate
17-09	1.0	0.05			none
17-10	1.0	0.05			glyphosate
17-11	1.0		0.100	PVA	none
17-12	1.0		0.025	PVA	none
17-13	1.0	0.05	0.025	PVA	none
17-14	1.0		0.100	sodium cholate	Na cholate
17-15	1.0		0.020	sodium cholate	Na cholate
17-16	1.0	0.05	0.020	sodium cholate	Na cholate
17-17	0.5				none
17-18	0.5	0.05			glyphosate
17-19	0.5	0.05	0.020	sodium cholate	Na cholate

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 19 days after planting ABUTH and 21 days after planting ECHCF, and evaluation of herbicidal inhibition was done 16 days after application.

In addition to compositions 17-01 to 17-19, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 at various concentrations. Formulations B and C alone were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 17b.

Table 17b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	200	32	25
	300	50	34
	400	54	35

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation C	200	59	92
	300	76	100
	400	93	97
Formulation B + Fluorad FC-135 0.25% w/v	200	43	48
	300	64	52
	400	84	71
Formulation B + Fluorad FC-135 0.1% w/v	200	61	78
	300	65	59
	400	100	86
Formulation B + Fluorad FC-135 0.05% w/v	200	58	30
	300	82	55
	400	88	77
Formulation C + Fluorad FC-135 0.25% w/v	200	53	55
	300	76	68
	400	88	93
Formulation C + Fluorad FC-135 0.1% w/v	200	59	70
	300	89	85
	400	93	83
Formulation C + Fluorad FC-135 0.05% w/v	200	60	72
	300	82	100
	400	94	94
17-01	200	73	52
	300	88	80
	400	94	90
17-02	200	83	80
	300	96	83
	400	97	95
17-03	200	86	73
	300	95	79
	400	98	94
17-04	200	73	72
	300	94	86
	400	96	93
17-05	200	67	68
	300	94	74
	400	96	91
17-06	200	65	61
	300	79	82
	400	91	81
17-07	200	75	65
	300	92	84
	400	98	91
17-08	200	66	70
	300	87	96
	400	97	97
17-09	200	83	73
	300	91	83
	400	97	89

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
17-10	200	89	70
	300	92	79
	400	91	74
17-11	200	65	58
	300	86	86
	400	97	100
17-12	200	75	64
	300	79	85
	400	91	87
17-13	200	79	53
	300	81	83
	400	96	88
17-14	200	56	69
	300	80	95
	400	92	93
17-15	200	57	77
	300	67	91
	400	88	90
17-16	200	88	82
	300	85	87
	400	76	72
17-17	200	53	66
	300	71	72
	400	87	83
17-18	200	89	85
	300	79	72
	400	65	60
17-19	200	77	65
	300	87	85
	400	92	94

In glyphosate compositions containing lecithin and Fluorad FC-135, no consistent difference in herbicidal effectiveness was observed between those where lecithin was sonicated alone (17-02, 17-07, 17-09) and those where glyphosate and lecithin were sonicated together (17-03, 17-08, 17-10). The anomalous inversion of the apparent rate response to glyphosate seen with composition 17-18 is believed to be the result of an error in application or recording and the data for this composition should be ignored in this Example.

EXAMPLE 18

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 18a. Process (iii) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of all compositions was adjusted to approximately 7.

Table 18a

Spray composition	Lecithin g/l	% w/w Fluorad FC-135	PVA	Components sonicated with lecithin
18-01	2.5			none
18-02	1.0			none
18-03	0.5			none
18-04	0.2			none
18-05	1.0	0.25		none
18-06	1.0	0.25		glyphosate
18-07	1.0	0.10		none
18-08	1.0	0.10		glyphosate
18-09	0.5	0.05		none
18-10	0.5	0.05		glyphosate
18-11	2.5		0.10	none

Hemp sesbania (Sesbania exaltata, SEBEX) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 22 days after planting SEBEX, and evaluation of herbicidal inhibition was done 21 days after application.

In addition to compositions 18-01 to 18-11, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 at various concentrations. Formulations B and C alone, and Formulation B tank mixed with 0.1% PVA (polyvinyl alcohol), were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 18b.

Table 18b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition SEBEX
Formulation B	500	43
	1000	54
	1500	44
Formulation B + PVA 0.1% w/v	500	53
	1000	45
	1500	44
Formulation C	500	56
	1000	62
	1500	63
Formulation B + Fluorad FC-135 0.25% w/v	500	40
	1000	45
	1500	60
Formulation B + Fluorad FC-135 0.1% w/v	500	33
	1000	51
	1500	53
Formulation B + Fluorad FC-135 0.05% w/v	500	21
	1000	18
	1500	29

Spray composition	Glyphosate rate g a.e./ha	% Inhibition SEBEX
Formulation C + Fluorad FC-135 0.25% w/v	500	34
	1000	41
	1500	58
Formulation C + Fluorad FC-135 0.1% w/v	500	50
	1000	43
	1500	52
Formulation C + Fluorad FC-135 0.05% w/v	500	48
	1000	49
	1500	46
18-01	500	22
	1000	33
	1500	37
18-02	500	16
	1000	24
	1500	28
18-03	500	15
	1000	24
	1500	27
18-04	500	17
	1000	13
	1500	31
18-05	500	28
	1000	64
	1500	68
18-06	500	64
	1000	51
	1500	61
18-07	500	65
	1000	51
	1500	63
18-08	500	50
	1000	56
	1500	30
18-09	500	40
	1000	59
	1500	66
18-10	500	31
	1000	23
	1500	49
18-11	500	43
	1000	39
	1500	74

Glyphosate activity on SEBEX was extremely weak in this test and no firm conclusions can be drawn.

EXAMPLE 19

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 19a. Process (iii) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of all compositions was adjusted to approximately 7.

Table 19a

Spray composition	Lecithin g/l	% w/w Fluorad FC-135	Components sonicated with lecithin
19-01	2.5		none
19-02	1.0		none
19-03	0.5		none
19-04	0.2		none
19-05	1.0	0.25	none
19-06	1.0	0.25	glyphosate

Sicklepod (Cassia obtusifolia, CASOB) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 22 days after planting CASOB, and evaluation of herbicidal inhibition was done 21 days after application.

In addition to compositions 19-01 to 19-06, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 at two concentrations. Formulations B and C alone were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 19b.

Table 19b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition CASOB
Formulation B	500	35
	800	37
	1200	34
Formulation C	500	49
	800	49
	1200	66
Formulation B + Fluorad FC-135 0.25% w/v	500	45
	800	50
	1200	71
Formulation B + Fluorad FC-135 0.1% w/v	500	49
	800	49
	1200	78
Formulation C + Fluorad FC-135 0.25% w/v	500	60
	800	75
	1200	68
Formulation C + Fluorad FC-135 0.1% w/v	500	47
	800	85
	1200	74

Spray composition	Glyphosate rate g a.e./ha	% Inhibition CASOB
19-01	500	54
	800	51
	1200	43
19-02	500	37
	800	69
	1200	52
19-03	500	35
	800	51
	1200	43
19-04	500	71
	800	69
	1200	57
19-05	500	47
	800	73
	1200	89
19-06	500	49
	800	51
	1200	73

On CASOB, the addition of Fluorad FC-135 to a glyphosate composition containing lecithin significantly enhanced herbicidal effectiveness (compare compositions 19-05 and 19-02). However, where glyphosate was sonicated together with the lecithin (composition 19-06), herbicidal effectiveness was reduced.

EXAMPLE 20

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 20a. Process (iii) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of all compositions was adjusted to approximately 7.

Table 20a

Spray composition	Lecithin g/l	% w/w		Components sonicated with lecithin
		Fluorad FC-135	Diacid 1550	
20-01	2.5			none
20-02	0.5			none
20-03	0.2			none
20-04	2.5	0.05		none
20-05	0.5	0.05		none
20-06	0.2	0.05		none
20-07	0.5		0.05	Diacid

Common lambsquarter (Chenopodium album, CHEAL) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 31 days after planting CHEAL, and evaluation of herbicidal inhibition was done 18 days after application.

In addition to compositions 20-01 to 20-07, spray compositions were prepared by tank mixing Formulations B and C with 0.5% Fluorad FC-135. Formulations B and C alone were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 20b.

Table 20b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition CHEAL
Formulation B	150	0
	250	0
	350	3
Formulation C	150	18
	250	68
	350	98
Formulation B + Fluorad FC-135 0.05% w/v	150	0
	250	10
	350	5
Formulation C + Fluorad FC-135 0.05% w/v	150	3
	250	50
	350	60
20-01	150	0
	250	27
	350	60
20-02	150	0
	250	5
	350	8
20-03	150	5
	250	0
	350	8
20-04	150	18
	250	29
	350	63
20-05	150	17
	250	14
	350	87
20-06	150	44
	250	40
	350	38
20-07	150	10
	250	35
	350	73

Glyphosate activity on CHEAL was very weak in this test and no definitive conclusions can be drawn. However, none of the compositions of the invention performed as well as the commercial standard Formulation C in this test. Fluorad FC-135 at the extremely low concentration of 0.05% was ineffective as a tank-mix additive, but addition of 0.05% Fluorad FC-135 did enhance the performance of compositions containing lecithin (compare compositions 20-04 to 20-06 with 20-01 to 20-03).

EXAMPLE 21

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 21a. Process (iii) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of all compositions was adjusted to approximately 7.

Table 21a

Spray composition	Lecithin g/l	% w/w			Components sonicated with lecithin
		Fluorad FC-135	Aerosol OT	Methyl caprate	
21-01	2.5				none
21-02	2.5				glyphosate
21-03	1.0				none
21-04	1.0				glyphosate
21-05	0.5				none
21-06	0.5				glyphosate
21-07	0.2				none
21-08	0.2				glyphosate
21-09	0.5		0.05		none
21-10	0.5		0.05		AOT, glyphosate
21-11	0.5		0.05		AOT
21-12	2.5	0.25			none
21-13	0.5	0.05			none
21-14	0.5	0.05			glyphosate
21-15	0.5			0.05	Me caprate
21-16	0.5	0.05		0.05	Me caprate
21-17	0.2	0.02			none
21-18	0.2	0.02			glyphosate
21-19	0.2			0.02	Me caprate

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF), and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 19 days after planting ABUTH and 22 days after planting ECHCF. No record was found for the planting date for SIDSP. Evaluation of herbicidal inhibition was done 20 days after application.

In addition to compositions 21-01 to 21-19, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 at various concentrations. Formulations B and C alone were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 21b.

Table 21b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Formulation B	150	16	23	30
	250	17	33	57
	350	24	43	65

Spray composition	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Formulation C	150	18	58	53
	250	30	71	79
	350	49	83	94
Formulation B + Fluorad FC-135 0.25% w/v	150	27	59	56
	250	45	84	81
	350	55	82	91
Formulation B + Fluorad FC-135 0.1% w/v	150	17	43	56
	250	21	56	75
	350	64	80	90
Formulation B + Fluorad FC-135 0.02% w/v	150	22	27	38
	250	37	49	69
	350	48	68	94
Formulation C + Fluorad FC-135 0.25% w/v	150	41	41	59
	250	57	53	85
	350	67	67	94
Formulation C + Fluorad FC-135 0.05% w/v	150	26	39	67
	250	46	66	88
	350	75	73	93
Formulation C + Fluorad FC-135 0.02% w/v	150	30	52	66
	250	67	50	89
	350	61	88	92
21-01	150	35	62	64
	250	63	77	90
	350	71	83	85
21-02	150	35	44	67
	250	53	79	86
	350	58	92	90
21-03	150	37	50	71
	250	53	76	90
	350	73	63	97
21-04	150	29	46	61
	250	43	77	85
	350	70	85	96
21-05	150	12	36	59
	250	43	55	83
	350	53	77	87
21-06	150	19	69	67
	250	62	47	84
	350	58	60	95
21-07	150	14	59	59
	250	39	63	75
	350	46	77	91
21-08	150	36	37	64
	250	38	68	82
	350	47	80	79
21-09	150	8	35	27
	250	9	51	56
	350	36	58	67

Spray composition	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
21-10	150	5	33	24
	250	15	73	47
	350	30	66	67
21-11	150	38	49	73
	250	62	75	89
	350	71	75	98
21-12	150	7	41	21
	250	18	67	38
	350	30	64	61
21-13	150	39	72	65
	250	65	55	76
	350	70	68	90
21-14	150	51	53	66
	250	60	82	85
	350	65	83	95
21-15	150	15	59	61
	250	31	54	83
	350	57	67	84
21-16	150	36	79	66
	250	50	60	95
	350	71	95	95
21-17	150	30	52	75
	250	54	60	84
	350	48	84	93
21-18	150	43	75	69
	250	47	78	88
	350	missing	missing	90
21-19	150	13	42	61
	250	29	51	79
	350	42	69	90

In this test the concentration of Fluorad FC-135 which had to be added in tank-mix to Formulation B to bring its herbicidal performance up to that of Formulation C was approximately 0.25% for ECHCF, 0.1% for SIDSP and 0.02% for ABUTH. The herbicidal effectiveness of composition 21-12 (0.25% lecithin, 0.25% Fluorad FC-135) was uncharacteristically weak in this test. However, composition 21-13 (0.05% lecithin, 0.05% Fluorad FC-135) performed well as in previous tests, exceeding the herbicidal effectiveness of Formulation C on ABUTH, at least equalling it on SIDSP and not quite equalling it on ECHCF. Contrary to results obtained in other tests, improved effectiveness on ECHCF and SIDSP was obtained by sonicating the glyphosate with the lecithin (composition 21-14 versus 21-13). The inclusion of methyl caprate (compositions 21-15 and 21-16) also improved efficacy on these species. Surprisingly high herbicidal effectiveness was seen in this test with compositions containing ultra-low concentrations of lecithin and Fluorad FC-135 (0.02% of each, 21-17 and 21-18).

EXAMPLE 22

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 22a. Process (iv) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of these compositions was not recorded.

Table 22a

Concentrate composition	% w/w			
	Glyphosate a.e.	Lecithin	MON 0818	Fluorad FC-135
22-01	10			5.0
22-02	10			10.0
22-03	10			12.5
22-04	10			15.0
22-05	10			20.0
22-06	10			30.0
22-07	15	4.0	1.0	
22-08	20	5.0	0.5	
22-09	20	5.0	1.0	
22-10	20	5.0	2.0	
22-11	20	4.0	1.0	
22-12	25	5.0	0.5	
22-13	25	5.0	1.0	
22-14	25	5.0	2.0	
22-15	25	4.0	1.0	
22-16	25	5.0	5.0	

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH and 16 days after planting ECHCF, and evaluation of herbicidal inhibition was done 14 days after application.

Formulation C was applied as a comparative treatment. Results, averaged for all replicates of each treatment, are shown in Table 22b.

Table 22b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation C	56	13	45
	112	43	75
	224	64	94
	448	88	97
22-01	112	38	61
	224	56	80
	448	76	97
22-02	112	50	51
	224	69	91
	448	81	97

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
22-03	112	51	63
	224	64	83
	448	81	96
22-04	112	53	61
	224	71	91
	448	78	95
22-05	112	41	56
	224	70	85
	448	75	97
22-06	112	38	53
	224	63	89
	448	75	94
22-07	112	48	53
	224	49	84
	448	75	90
22-08	112	31	60
	224	53	84
	448	66	90
22-09	112	26	56
	224	53	85
	448	78	96
22-10	112	36	60
	224	53	85
	448	79	98
22-11	112	41	59
	224	49	73
	448	76	95
22-12	112	30	56
	224	50	74
	448	65	89
22-13	112	34	55
	224	44	80
	448	73	95
22-14	112	39	61
	224	56	85
	448	69	91
22-15	112	31	55
	224	56	69
	448	79	95
22-16	112	29	64
	224	58	86
	448	78	91

None of the concentrate compositions of this Example containing 10% glyphosate a.e. and varying amounts of Fluorad FC-135 (22-01 to 22-06) exhibited greater herbicidal effectiveness than the commercial standard Formulation C. It should be noted that the amounts of Fluorad FC-135 used in this

Example were extremely high, the weight/weight ratio of Fluorad FC-135 to glyphosate a.e. ranging from 1:2 to 3:1.

EXAMPLE 23

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 23a. Process (iv) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of all compositions was approximately 5.

Table 23a

Concentrate composition	% w/w				Components sonicated with lecithin
	Glyphosate a.e.	Lecithin	MON 0818	Fluorad FC-135	
23-01	20	5.0	2.0		none
23-02	20	4.0	1.0		none
23-03	20	5.0	2.0		glyphosate
23-04	20	4.0	1.0		glyphosate
23-05	20	5.0	2.0	5.0	none

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and 18 days after planting ECHCF, and evaluation of herbicidal inhibition was done 14 days after application.

Formulations B and C were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 23b.

Table 23b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	112	33	53
	224	58	78
	336	80	89
	448	79	88
Formulation C	112	49	79
	224	59	94
	336	84	100
	448	95	100
23-01	112	39	66
	224	63	93
	336	81	98
	448	86	100
23-02	112	29	46
	224	55	83
	336	79	91
	448	85	95

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
23-03	112	30	59
	224	60	98
	336	80	100
	448	81	100
23-04	112	26	51
	224	53	83
	336	76	86
	448	86	99
23-05	112	46	51
	224	59	89
	336	79	96
	448	89	98

Concentrate composition 23-05 (5% lecithin, 2% MON 0818, 5% Fluorad FC-135) did not exhibit greater herbicidal effectiveness in this test than composition 23-01 lacking the Fluorad FC-135.

EXAMPLE 24

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 24a. Process (iii) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of these compositions was not recorded.

Table 24a

Spray composition	Lecithin g/l	% w/w Fluorad FC-135	Components sonicated with lecithin
24-01	2.5		none
24-02	1.0		none
24-03	0.5		none
24-04	0.2		none
24-05	0.1		none
24-06	2.5	0.25	none
24-07	0.5	0.05	none
24-08	0.2	0.02	none
24-09	0.2	0.02	glyphosate
24-10	0.2	0.02	FC-135
24-11	0.1	0.01	none
24-12	0.1	0.01	glyphosate
24-13	0.1	0.02	FC-135
24-14	0.5	0.02	none
24-15	0.5	0.02	glyphosate
24-16	0.5	0.02	FC-135

Yellow nutsedge (Cyperus esculentus, CYPES) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 29 days after planting, and evaluation of herbicidal inhibition was done 33 days after application.

In addition to compositions 24-01 to 24-16, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 at various concentrations. Formulations B and C alone were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 24b.

Table 24b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition CYPES
Formulation B	400	32
	750	68
	1000	70
Formulation C	400	25
	750	66
	1000	89
Formulation B + Fluorad FC-135 0.25% w/v	400	49
	750	75
	1000	82
Formulation B + Fluorad FC-135 0.05% w/v	400	53
	750	74
	1000	64
Formulation B + Fluorad FC-135 0.02% w/v	400	56
	750	83
	1000	83
Formulation B + Fluorad FC-135 0.01% w/v	400	61
	750	67
	1000	88
Formulation C + Fluorad FC-135 0.25% w/v	400	73
	750	47
	1000	79
Formulation C + Fluorad FC-135 0.05% w/v	400	50
	750	73
	1000	81
Formulation C + Fluorad FC-135 0.02% w/v	400	41
	750	79
	1000	81
Formulation C + Fluorad FC-135 0.01% w/v	400	67
	750	77
	1000	72
24-01	400	62
	750	73
	1000	100
24-02	400	61
	750	85
	1000	92
24-03	400	81
	750	83
	1000	87

Spray composition	Glyphosate rate g a.e./ha	% Inhibition CYPES
24-04	400	59
	750	79
	1000	79
24-05	400	69
	750	69
	1000	91
24-06	400	75
	750	80
	1000	96
24-07	400	65
	750	69
	1000	89
24-08	400	67
	750	69
	1000	87
24-09	400	76
	750	77
	1000	80
24-10	400	71
	750	75
	1000	86
24-11	400	69
	750	77
	1000	85
24-12	400	59
	750	85
	1000	95
24-13	400	61
	750	75
	1000	81
24-14	400	64
	750	83
	1000	90
24-15	400	53
	750	81
	1000	86
24-16	400	85
	750	86
	1000	81

The tank-mix treatments of this Example show surprisingly little effect on herbicidal effectiveness on CYPES of reducing Fluorad FC-135 concentration from 0.25% all the way down to 0.01%. At this extraordinarily low concentration, the tank mix of Formulation B with Fluorad FC-135 still performed equal or better than Formulation C alone. Lecithin alone was an unexpectedly effective

excipient for glyphosate in this test (see compositions 24-01 to 24-05) and the addition of Fluorad FC-135 to lecithin did not in every case give further enhancement of herbicidal efficacy.

EXAMPLE 25

Glyphosate-containing spray compositions were prepared by tank-mixing Formulation B with excipients as shown in Table 25. Soybean lecithin (20% phospholipid, Avanti) was used in the form of a 10% dispersion prepared by sonication as in process (iii).

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 21 days after planting ABUTH and 21 days after planting ECHCF, and evaluation of herbicidal inhibition was done 21 days after application. Results, averaged for all replicates of each treatment, are shown in Table 25.

Table 25

Glyphosate composition	Glyphosate rate g a.e./ha	Additive	Add. rate % w/v	% Inhibition ABUTH	% Inhibition ECHCF
Formulation B	56			3	17
	112			7	38
	224			30	58
	336			60	67
None	0	MON 0818	5.0	7	30
		Fluorad FC-135	5.0	5	3
		lecithin	5.0	0	0
Formulation B	56	MON 0818	0.005	0	48
	112			3	60
	224			53	85
	336			58	87
Formulation B	56	MON 0818	0.01	3	50
	112			10	67
	224			52	87
	336			67	92
Formulation B	56	MON 0818	0.05	7	52
	112			10	67
	224			60	93
	336			68	96
Formulation B	56	MON 0818	0.1	10	55
	112			12	70
	224			57	97
	336			80	97
Formulation B	56	MON 0818	0.2	10	65
	112			22	70
	224			58	97
	336			85	97
Formulation B	56	MON 0818	0.5	13	65
	112			33	77
	224			72	99
	336			88	100

Glyphosate composition	Glyphosate rate g a.e./ha	Additive	Add. rate % w/v	% Inhibition	
				ABUTH	ECHCF
Formulation B	56	MON 0818	1.0	15	68
	112			55	80
	224			78	98
	336			95	100
Formulation B	56	MON 0818	2.0	27	75
	112			62	78
	224			83	100
	336			100	99
Formulation B	56	MON 0818	5.0	23	55
	112			53	77
	224			72	90
	336			97	88
Formulation B	56	Fluorad FC-135	0.005	2	47
	112			10	50
	224			25	70
	336			55	78
Formulation B	56	Fluorad FC-135	0.01	7	40
	112			15	57
	224			70	67
	336			80	80
Formulation B	56	Fluorad FC-135	0.05	2	48
	112			15	57
	224			70	78
	336			78	88
Formulation B	56	Fluorad FC-135	0.1	5	45
	112			18	58
	224			75	87
	336			80	90
Formulation B	56	Fluorad FC-135	0.2	12	48
	112			27	60
	224			75	90
	336			97	93
Formulation B	56	Fluorad FC-135	0.5	3	47
	112			12	57
	224			75	80
	336			78	83
Formulation B	56	Fluorad FC-135	1.0	5	43
	112			10	52
	224			77	75
	336			78	77
Formulation B	56	Fluorad FC-135	2.0	7	42
	112			10	47
	224			65	65
	336			72	77
Formulation B	56	Fluorad FC-135	5.0	2	38
	112			5	47
	224			63	60
	336			67	63

Glyphosate composition	Glyphosate rate g a.e./ha	Additive	Add. rate % w/v	% Inhibition	
				ABUTH	ECHCF
Formulation B	56	lecithin	0.005	0	10
	112			10	45
	224			67	70
	336			67	77
Formulation B	56	lecithin	0.01	2	20
	112			12	47
	224			63	70
	336			68	85
Formulation B	56	lecithin	0.05	3	32
	112			12	52
	224			63	73
	336			72	82
Formulation B	56	lecithin	0.1	8	37
	112			10	50
	224			65	73
	336			78	83
Formulation B	56	lecithin	0.2	5	45
	112			43	63
	224			68	82
	336			80	92
Formulation B	56	lecithin	0.5	13	50
	112			42	65
	224			67	88
	336			68	87
Formulation B	56	lecithin	1.0	13	52
	112			50	72
	224			67	80
	336			68	88
Formulation B	56	lecithin	2.0	10	53
	112			37	72
	224			72	88
	336			87	97
Formulation B	56	lecithin	5.0	10	50
	112			55	73
	224			72	80
	336			78	95

This test was an expanded rate titration study of MON 0818, Fluorad FC-135 and lecithin as tank-mix adjuvants for glyphosate as Formulation B. On ABUTH, the optimum adjuvant concentration was 2.0% for MON 0818, 0.2% for Fluorad FC-135 and 0.2% or higher for lecithin. On ECHCF, the optimum adjuvant concentration was 0.5% to 2.0% for MON 0818, 0.2% for Fluorad FC-135 and 2.0% for lecithin.

EXAMPLE 26

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient

ingredients as shown in Table 26a. Process (iii) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of all compositions was adjusted to approximately 7.

Table 26a

Spray composition	Lecithin g/l	% w/w	
		Fluorad FC-135	Aerosol OT
26-01			0.1
26-02			0.05
26-03			0.02
26-04		0.1	0.1
26-05		0.05	0.05
26-06		0.02	0.02
26-07	1.0		0.10
26-08	1.0	0.10	0.10
26-09	1.0		
26-10	1.0	0.10	
26-11	0.5		
26-12	0.5		0.05
26-13	0.5	0.05	
26-14	0.5	0.05	0.05
26-15	0.2		
26-16	0.2		0.02
26-17	0.2	0.02	
26-18	0.2	0.02	0.02

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH, 19 days after planting ECHCF, and 26 days after planting SIDSP. Evaluation of herbicidal inhibition was done for ABUTH and ECHCF 15 days after application and for SIDSP 21 days after application.

In addition to compositions 26-01 to 26-18, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 at various concentrations. Formulations B and C alone were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 26b.

Table 26b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Formulation B	150	37	71	57
	250	57	79	69
	400	74	86	80
	500	79	89	74
Formulation C	150	48	42	58
	250	71	80	81
	400	88	100	88
	500	92	100	86

Spray composition	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Formulation B + Fluorad FC-135 0.1% w/v	150	87	62	66
	250	87	96	70
	400	91	94	75
Formulation B + Fluorad FC-135 0.05% w/v	150	61	48	65
	250	81	69	71
	400	90	91	67
Formulation B + Fluorad FC-135 0.02% w/v	150	58	32	62
	250	75	49	51
	400	81	83	73
Formulation C + Fluorad FC-135 0.1% w/v	150	78	61	76
	250	79	77	81
	400	93	100	78
Formulation C + Fluorad FC-135 0.05% w/v	150	43	86	69
	250	79	100	80
	400	95	98	84
Formulation C + Fluorad FC-135 0.02% w/v	150	39	56	77
	250	77	100	86
	400	88	100	80
26-01	150	63	48	49
	250	70	69	66
	400	85	84	63
26-02	150	32	36	55
	250	64	74	65
	400	77	92	69
26-03	150	30	78	51
	250	59	79	66
	400	83	93	74
26-04	150	86	50	65
	250	74	98	71
	400	81	89	75
26-05	150	85	55	60
	250	81	75	73
	400	82	81	64
26-06	150	61	67	45
	250	66	78	61
	400	83	77	67
26-07	150	46	38	44
	250	56	85	64
	400	75	96	78
26-08	150	88	63	70
	250	87	73	79
	400	91	82	75
26-09	150	63	72	61
	250	87	73	71
	400	89	87	80
26-10	150	81	72	61
	250	85	62	82
	400	87	89	76

Spray composition	Glyphosate rate g a.c./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
26-11	150	54	57	68
	250	80	90	74
	400	84	95	66
26-12	150	27	53	47
	250	57	71	67
	400	72	91	70
26-13	150	78	59	64
	250	80	84	80
	400	89	76	77
26-14	150	84	52	68
	250	88	69	75
	400	90	84	66
26-15	150	51	57	55
	250	81	55	71
	400	88	83	69
26-16	150	40	68	46
	250	74	89	60
	400	77	98	63
26-17	150	64	44	58
	250	80	93	81
	400	87	99	69
26-18	150	64	87	50
	250	77	75	70
	400	90	89	50

This test was designed in part to explore the relative contribution of Fluorad FC-135 and lecithin to the herbicidal effectiveness of glyphosate compositions comprising both of these excipient substances. Fluorad FC-135 was applied as sole excipient at concentrations of 1.0%, 0.5% and 0.2% (see tank-mix treatments with Formulation B). Lecithin was applied as sole excipient at the same three concentrations in compositions 26-09, 26-11 and 26-15. Combinations of the two excipients at equal concentrations were applied in corresponding compositions 26-10, 26-13 and 26-17. The data are highly variable but an overall trend can be discerned. When only one of the two excipients was present, herbicidal effectiveness tended to drop off as the concentration of that excipient was reduced. When both excipients were present, there was scarcely any decline in herbicidal effectiveness as excipient concentration was reduced. Although averages of data from three glyphosate rates across three species can be misleading, it is helpful in this case to reduce the mass of individual data to the following such averages of percent inhibition:

Glyphosate (Formulation B)	68%
Glyphosate + 0.1% Fluorad FC-135	81%
Glyphosate + 0.05% Fluorad FC-135	71%
Glyphosate + 0.02% Fluorad FC-135	63%

Glyphosate + 0.1% lecithin	76%
Glyphosate + 0.05% lecithin	74%
Glyphosate + 0.02% lecithin	68%
Glyphosate + 0.1% Fluorad FC-135 + 0.1% lecithin	77%
Glyphosate + 0.05% Fluorad FC-135 + 0.05% lecithin	76%
Glyphosate + 0.02% Fluorad FC-135 + 0.02% lecithin	75%
Glyphosate commercial standard (Formulation C)	73%

Thus, when both excipients are used together, a fivefold decrease in excipient concentration results in a decline in overall herbicidal effectiveness of only 2 percentage points, still retaining overall effectiveness at least equal to that of the commercial standard.

EXAMPLE 27

Glyphosate-containing spray compositions were prepared by tank-mixing Formulations B with excipients as shown in Table 27. Soybean lecithin (20% phospholipid, Avanti) was used in the form of a 10% dispersion prepared by sonication as in process (iii).

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 19 days after planting ABUTH and 15 days after planting ECHCF, and evaluation of herbicidal inhibition was done 19 days after application. Results, averaged for all replicates of each treatment, are shown in Table 27.

Table 27

Glyphosate composition	Glyphosate rate g a.e./ha	Additive	Additive rate % v/v	% Inhibition	
				ABUTH	ECHCF
Formulation B	56	none		0	3
	112			5	13
	224			40	40
	336			83	77
Formulation B	56	Fluorad FC-135	0.005	0	7
	112			3	10
	224			45	53
	336			58	78
Formulation B	56	Fluorad FC-135	0.01	0	8
	112			2	12
	224			45	60
	336			67	87
Formulation B	56	Fluorad FC-135	0.05	2	8
	112			20	23
	224			72	88
	336			90	93
Formulation B	56	Fluorad FC-135	0.1	3	10
	112			33	38
	224			73	88
	336			93	92

Glyphosate composition	Glyphosate rate g a.e./ha	Additive	Additive rate % v/v	% Inhibition	
				ABUTH	ECHCF
Formulation B	56	Fluorad FC-135	0.2	10	17
	112			33	47
	224			77	85
	336			93	92
Formulation B	56	Fluorad FC-135	0.5	7	13
	112			37	37
	224			80	85
	336			96	95
Formulation B	56	Fluorad FC-135	1.0	3	7
	112			27	35
	224			72	87
	336			88	92
Formulation B	56	Fluorad FC-135	2.0	0	0
	112			27	18
	224			72	75
	336			87	87
Formulation B	56	Fluorad FC-135	5.0	0	0
	112			12	13
	224			43	50
	336			58	53
Formulation B	56	lecithin/FC-135 (1:1)	0.005	0	2
	112			7	13
	224			65	63
	336			83	82
Formulation B	56	lecithin/FC-135 (1:1)	0.01	0	0
	112			3	10
	224			42	63
	336			73	82
Formulation B	56	lecithin/FC-135 (1:1)	0.05	0	0
	112			42	13
	224			68	73
	336			98	73
Formulation B	56	lecithin/FC-135 (1:1)	0.1	0	0
	112			37	20
	224			62	68
	336			94	77
Formulation B	56	lecithin/FC-135 (1:1)	0.2	0	2
	112			33	28
	224			67	68
	336			100	78
Formulation B	56	lecithin/FC-135 (1:1)	0.5	7	0
	112			40	18
	224			68	68
	336			90	73
Formulation B	56	lecithin/FC-135 (1:1)	1.0	17	3
	112			43	45
	224			83	88
	336			95	94

Glyphosate composition	Glyphosate rate g a.e./ha	Additive	Additive rate % v/v	% Inhibition	
				ABUTH	ECHCF
Formulation B	56	lecithin/FC-135 (1:1)	2.0	10	23
	112			32	42
	224			63	73
	336			88	87
Formulation B	56	lecithin/FC-135 (1:1)	5.0	2	3
	112			18	28
	224			50	72
	336			85	87
Formulation B	56	lecithin	0.005	2	2
	112			3	10
	224			45	50
	336			58	72
Formulation B	56	lecithin	0.01	0	2
	112			2	12
	224			40	52
	336			65	75
Formulation B	56	lecithin	0.05	2	2
	112			0	10
	224			40	45
	336			57	70
Formulation B	56	lecithin	0.1	2	7
	112			2	13
	224			33	37
	336			48	67
Formulation B	56	lecithin	0.2	3	3
	112			3	13
	224			32	35
	336			47	68
Formulation B	56	lecithin	0.5	2	3
	112			8	15
	224			47	53
	336			67	65
Formulation B	56	lecithin	1.0	2	5
	112			10	15
	224			33	55
	336			70	77
Formulation B	56	lecithin	2.0	5	8
	112			12	17
	224			48	52
	336			68	77
Formulation B	56	lecithin	5.0	5	17
	112			23	17
	224			52	55
	336			73	78

This tank-mix study more clearly demonstrates the surprising interaction seen in Example 26 between lecithin and Fluorad FC-135 as excipients for glyphosate. For example, glyphosate alone over

four rates gave average inhibition of ABUTH of 32%. Adding Fluorad FC-135 at a concentration of 0.5% boosted the average inhibition to 55%, but adding lecithin at the same concentration did not raise average inhibition above 32%. A 1:1 combination of both excipients at the same total concentration gave an average inhibition of 51%. At a concentration of 0.1%, Fluorad FC-135 gave average inhibition of 50%, lecithin 21% (i.e. a reduction in effectiveness of glyphosate) and the 1:1 combination 48%. Thus, as in Example 26, the decline in herbicidal effectiveness with reducing excipient rate was much less pronounced with the combination than with either excipient on its own.

EXAMPLE 28

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 28a. Process (i) was followed for compositions 28-01 to 28-06. Process (iv) was followed for compositions 28-07 to 28-11, using soybean lecithin (20% phospholipid, Avanti). For compositions 28-12 and 28-13, process (iv) was also used, but Aerosol OT was the aggregate-forming material employed in place of lecithin. The pH of all compositions was approximately 5.

Table 28a

Concentrate composition	% w/w					(*) Other components
	Glyphosate a.e.	Lecithin	Fluorad FC-135	MON 0818	Other (*)	
28-01	20				1.0	PVA
28-02	20		5.0		1.0	PVA
28-03	20		2.0		1.0	PVA
28-04	20		1.0		1.0	PVA
28-05	20				0.5	Kelzan
28-06	20		2.0		0.5	Kelzan
28-07	20	2.0		0.04		
28-08	20	2.0	2.0	0.04		
28-09	20	2.0	2.0	0.02		
28-10	20	2.0		0.04	25.0	Silwet 800
28-11	20	2.0	2.0	0.04	25.0	Silwet 800
28-12	20				5.0	Aerosol OT
28-13	20				5.0 + 25.0	Aerosol OT + Silwet 800

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH and 17 days after planting ECHCF, and evaluation of herbicidal inhibition was done 38 days after application.

Formulations B and C were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 28b.

Table 28b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition ABUTH	% Inhibition ECHCF
Formulation B	56	0	8
	112	4	33
	224	45	40
	336	69	65
Formulation C	56	0	10
	112	5	43
	224	68	73
	336	87	94
28-01	112	0	40
	224	50	76
	336	76	85
28-02	112	1	35
	224	30	70
	336	69	96
28-03	112	6	35
	224	35	58
	336	65	84
28-04	112	1	35
	224	70	60
	336	69	85
28-05	112	1	35
	224	63	68
	336	80	88
28-06	112	0	25
	224	40	55
	336	66	73
28-07	112	11	35
	224	45	68
	336	65	86
28-08	112	9	38
	224	65	60
	336	66	75
28-09	112	10	33
	224	56	60
	336	78	75
28-10	112	30	5
	224	79	30
	336	90	35
28-11	112	60	5
	224	79	33
	336	96	30
28-12	112	8	11
	224	53	40
	336	66	64
28-13	112	40	6
	224	91	33
	336	98	38

Concentrate compositions 28-08 and 28-09 did not in this test exhibit herbicidal effectiveness equal to Formulation C.

EXAMPLE 29

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 29a. Process (iii) was followed for all compositions, using soybean lecithin (20% or 45% phospholipid as indicated below, both sourced from Avanti). The pH of all compositions was adjusted to approximately 7.

Table 29a

Spray composition	Lecithin		% w/w
	g/l	phospholipid %	Fluorad FC-135
29-01	0.25	20	
29-02	0.05	20	
29-03	0.02	20	
29-04	0.01	20	
29-05	0.25	20	0.25
29-06	0.05	20	0.05
29-07	0.02	20	0.02
29-08	0.01	20	0.01
29-09	0.25	45	
29-10	0.05	45	
29-11	0.02	45	
29-12	0.01	45	
29-13	0.25	45	0.25
29-14	0.05	45	0.05
29-15	0.02	45	0.02
29-16	0.01	45	0.01

Yellow nutsedge (Cyperus esculentus, CYPES) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 27 days after planting CYPES. Evaluation was done 27 days after application.

In addition to compositions 29-01 to 29-16, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 at various concentrations. Formulations B and C were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 29b.

Table 29b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition
		CYPES
Formulation B	500	25
	800	41
	1200	59

Spray composition	Glyphosate rate g a.e./ha	% Inhibition CYPES
Formulation C	500	29
	800	43
	1200	62
Formulation B + Fluorad FC-135 0.25% w/v	500	60
	800	57
	1200	79
Formulation B + Fluorad FC-135 0.05% w/v	500	63
	800	54
	1200	65
Formulation B + Fluorad FC-135 0.02% w/v	500	50
	800	71
	1200	60
Formulation B + Fluorad FC-135 0.01% w/v	500	27
	800	35
	1200	81
Formulation C + Fluorad FC-135 0.25% w/v	500	41
	800	72
	1200	75
Formulation C + Fluorad FC-135 0.05% w/v	500	52
	800	43
	1200	63
Formulation C + Fluorad FC-135 0.02% w/v	500	76
	800	72
	1200	82
Formulation C + Fluorad FC-135 0.01% w/v	500	38
	800	59
	1200	72
29-01	500	51
	800	70
	1200	64
29-02	500	58
	800	69
	1200	77
29-03	500	49
	800	67
	1200	85
29-04	500	51
	800	76
	1200	77
29-05	500	37
	800	73
	1200	100
29-06	400	72
	750	62
	1000	67
29-07	400	68
	750	75
	1000	86

Spray composition	Glyphosate rate g a.e./ha	% Inhibition CYPES
29-08	400	59
	750	78
	1000	88
29-09	400	72
	750	80
	1000	88
29-10	400	67
	750	77
	1000	89
29-11	400	67
	750	75
	1000	66
29-12	400	55
	750	75
	1000	83
29-13	400	33
	750	59
	1000	73
29-14	400	63
	750	77
	1000	76
29-15	400	35
	750	75
	1000	88
29-16	400	77
	750	66
	1000	86

This test was conducted to investigate the effect of phospholipid content of lecithin on herbicidal efficacy of lecithin-containing glyphosate compositions. No clear pattern emerged from this study, but overall it appeared that the crude lecithin (20% phospholipid) provided greater herbicidal effectiveness on CYPES than the de-oiled lecithin (45% phospholipid), suggesting that the oil present in crude lecithin might be having an adjuvant effect on this species.

EXAMPLE 30

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 30a. Process (iii) was followed for all compositions, using soybean lecithin (20%, 45% or 95% phospholipid as indicated below, all sourced from Avanti). The pH of all compositions was adjusted to approximately 7.

Table 30a

Spray composition	Lecithin		% w/w
	g/l	phospholipid %	Fluorad FC-135
30-01	0.5	20	
30-02	0.2	20	

Spray composition	Lecithin		% w/w
	g/l	phospholipid %	Fluorad FC-135
30-03	0.1	20	
30-04	0.5	45	
30-05	0.2	45	
30-06	0.1	45	
30-07	0.5	95	
30-08	0.2	95	
30-09	0.1	95	
30-10	0.5	20	0.05
30-11	0.5	45	0.05
30-12	0.5	95	0.05
30-13	0.2	20	0.02
30-14	0.2	45	0.02
30-15	0.2	95	0.02
30-16	0.1	20	0.01
30-17	0.1	45	0.01
30-18	0.1	95	0.01

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH, 19 days after planting ECHCF, and 23 days after planting SIDSP. Evaluation of herbicidal inhibition was done 15 days after application.

In addition to compositions 30-01 to 30-18, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 at various concentrations. Formulations B and C alone were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 30b.

Table 30b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Formulation B	100	10	25	33
	200	22	29	49
	300	50	62	61
	400	62	62	64
Formulation C	100	14	40	34
	200	53	98	66
	300	74	100	84
	400	86	100	93
Formulation B + Fluorad FC-135 0.05% w/v	100	18	25	34
	200	50	58	52
	300	68	83	70
Formulation B + Fluorad FC-135 0.02% w/v	100	10	21	29
	200	64	40	46
	300	79	62	64

Spray composition	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Formulation B + Fluorad FC-135 0.01% w/v	100	10	21	34
	200	34	27	44
	300	73	74	69
Formulation C + Fluorad FC-135 0.05% w/v	100	65	53	58
	200	73	77	65
	300	94	99	73
Formulation C + Fluorad FC-135 0.02% w/v	100	68	94	61
	200	63	93	66
	300	85	90	79
Formulation C + Fluorad FC-135 0.01% w/v	100	72	67	53
	200	69	99	61
	300	81	99	83
30-01	100	32	26	39
	200	72	60	56
	300	84	72	69
30-02	100	14	23	43
	200	70	42	63
	300	83	74	68
30-03	100	6	25	42
	200	55	47	57
	300	65	64	72
30-04	100	29	31	42
	200	55	65	60
	300	82	54	73
30-05	100	14	22	41
	200	32	35	66
	300	81	98	70
30-06	100	9	26	29
	200	47	48	57
	300	69	71	71
30-07	100	30	22	50
	200	73	50	69
	300	82	86	67
30-08	100	41	23	53
	200	57	38	69
	300	76	46	84
30-09	100	32	17	45
	200	60	37	67
	300	78	77	73
30-10	100	58	27	62
	200	91	42	79
	300	93	95	77
30-11	100	66	58	63
	200	91	79	69
	300	91	84	84
30-12	100	61	27	67
	200	90	72	77
	300	93	83	84

Spray composition	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
30-13	100	61	24	51
	200	88	48	69
	300	94	54	75
30-14	100	66	25	56
	200	90	49	72
	300	93	73	85
30-15	100	63	23	61
	200	88	33	72
	300	95	75	81
30-16	100	75	25	56
	200	87	37	74
	300	93	71	77
30-17	100	63	17	59
	200	92	27	73
	300	92	83	78
30-18	100	67	22	53
	200	91	38	68
	300	91	46	77

In general, across the three species included in this test, compositions containing the 45% phospholipid grade of soybean lecithin provided slightly greater herbicidal effectiveness than those containing the 20% grade. Any further improvement obtained by using the 95% grade was minimal and would likely not justify the considerably increased cost of this grade. The data of this test clearly show a non-additive interaction between lecithin and Fluorad FC-135. To take just one example for illustration, glyphosate alone (Formulation B) at 200 g a.e./ha gave 22% inhibition of ABUTH, 29% inhibition of ECHCF and 49% inhibition of SIDSP. Adding 0.02% Fluorad FC-135 brought these percentage inhibitions to 64%, 40% and 46% respectively. Alternatively, adding the 45% grade of lecithin at 0.02% (composition 30-05) resulted in percentage inhibitions of 32%, 35% and 36% respectively. Adding both these excipients, each at 0.02% (composition 30-14) gave percentage inhibitions of 90%, 49% and 72% respectively. Even adding both excipients so that the total excipient concentration was 0.02% (composition 30-17) resulted in percentage inhibitions of 92%, 27% and 73% respectively. Thus at least on the broadleaf species (ABUTH and SIDSP) there is strong evidence of a synergistic interaction between these two excipient substances.

EXAMPLE 31

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 31a. Process (iii) was followed for all compositions, using lecithin (20% or 95% phospholipid from soybean, or 95% phospholipid from egg yolk, all sourced from Avanti). The pH of all compositions was adjusted to approximately 7.

Table 31a

Spray composition	Lecithin			% w/w	
	g/l	phospho-lipid %	source	Fluorad FC-135	Fluorad FC-754
31-01	0.05	95	egg yolk		
31-02	0.02	95	egg yolk		
31-03	0.01	95	egg yolk		
31-04	0.05	95	soybean		
31-05	0.02	95	soybean		
31-06	0.01	95	soybean		
31-07	0.05	95	egg yolk	0.05	
31-08	0.02	95	egg yolk	0.02	
31-09	0.01	95	egg yolk	0.01	
31-10	0.05	95	soybean	0.05	
31-11	0.02	95	soybean	0.02	
31-12	0.01	95	soybean	0.01	
31-13	0.05	20	soybean		0.05
31-14	0.02	20	soybean		0.02

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 18 days after planting ABUTH and 19 days after planting ECHCF, and evaluation of herbicidal inhibition was done 15 days after application.

In addition to compositions 31-01 to 31-14, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 or Fluorad FC-754 at various concentrations. Formulations B and C alone were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 31b.

Table 31b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	1	27
	200	6	28
	300	21	35
	400	31	46
Formulation C	100	10	31
	200	28	36
	300	62	66
	400	77	74
Formulation B + Fluorad FC-135 0.05% w/v	100	19	24
	200	37	40
	300	62	52
Formulation B + Fluorad FC-135 0.02% w/v	100	7	13
	200	42	27
	300	56	57

Spray composition	Glyphosate rate g a.e./ha	% Inhibition ABUTH	% Inhibition ECHCF
Formulation B + Fluorad FC-135 0.01% w/v	100	23	19
	200	43	24
	300	60	40
Formulation B + Fluorad FC-754 0.05% w/v	100	19	23
	200	41	33
	300	67	62
Formulation B + Fluorad FC-754 0.02% w/v	100	12	19
	200	31	44
	300	61	45
Formulation C + Fluorad FC-135 0.05% w/v	100	37	39
	200	49	43
	300	66	62
Formulation C + Fluorad FC-135 0.02% w/v	100	18	31
	200	47	44
	300	68	49
Formulation C + Fluorad FC-135 0.01% w/v	100	26	27
	200	36	44
	300	54	82
Formulation C + Fluorad FC-754 0.05% w/v	100	34	32
	200	47	37
	300	62	62
Formulation C + Fluorad FC-754 0.02% w/v	100	28	32
	200	45	60
	300	43	75
31-01	100	16	36
	200	54	56
	300	66	61
31-02	100	23	43
	200	45	45
	300	65	51
31-03	100	31	35
	200	37	45
	300	53	60
31-04	100	24	35
	200	43	43
	300	78	50
31-05	100	24	36
	200	45	44
	300	58	66
31-06	100	31	24
	200	46	34
	300	52	51
31-07	100	49	33
	200	65	39
	300	73	63
31-08	100	48	25
	200	70	49
	300	73	69

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
31-09	100	45	27
	200	59	53
	300	71	84
31-10	100	60	30
	200	64	89
	300	75	99
31-11	100	47	51
	200	66	65
	300	80	78
31-12	100	49	39
	200	60	59
	300	67	84
31-13	100	50	30
	200	70	51
	300	68	66
31-14	100	54	33
	200	61	44
	300	79	66

In this test, glyphosate compositions containing egg yolk lecithin (31-01 to 31-03) performed similarly to those containing soybean lecithin (31-04 to 31-06) on ABUTH but were generally more effective than those containing soybean lecithin on ECHCF, at least in the absence of Fluorad FC-135. Addition of Fluorad FC-135, as in compositions 31-07 to 31-12, enhanced effectiveness of all compositions.

EXAMPLE 32

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 32a. Process (iii) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of all compositions was adjusted to approximately 7.

Table 32a

Spray composition	Lecithin g/l	% w/w fluoro-organic	Type of fluoro-organic
32-01	0.20		none
32-02	0.20	0.02	Fluorad FC-135
32-03	0.20	0.02	Fluorad FC-431
32-04	0.20	0.02	Fluorad FC-751
32-05	0.20	0.02	Fluorad FC-170C
32-06	0.20	0.02	Fluorad FC-171
32-07	0.20	0.02	Fluorad FC-754
32-08	0.50		none
32-09	0.10		none
32-10	0.04		none
32-11	0.02		none

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 18 days after planting ABUTH and ECHCF, and 27 days after planting SIDSP. Evaluation of herbicidal inhibition was done 15 days after application.

In addition to compositions 32-01 to 32-11, spray compositions were prepared by tank mixing Formulations B and C with various fluoro-organic surfactants of the Fluorad range, all at 0.02%. Formulations B and C alone were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 32b.

Table 32b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Formulation B	150	8	35	35
	250	21	47	37
	350	31	36	56
	450	57	52	64
Formulation C	150	29	69	49
	250	55	90	67
	350	75	91	75
	450	82	91	85
Formulation B + Fluorad FC-135 0.02% w/v	150	17	43	36
	250	39	58	53
	350	52	53	68
Formulation B + Fluorad FC-170C 0.02% w/v	150	13	25	32
	250	31	47	36
	350	31	85	61
Formulation B + Fluorad FC-171 0.02%w/v	150	8	52	15
	250	10	47	44
	350	15	58	55
Formulation B + Fluorad FC-431 0.02% w/v	150	14	36	34
	250	23	53	53
	350	37	61	62
Formulation B + Fluorad FC-751 0.02%w/v	150	12	29	29
	250	30	38	41
	350	43	36	58
Formulation B + Fluorad FC-754 0.02% w/v	150	21	27	33
	250	31	36	49
	350	38	51	59
Formulation C + Fluorad FC-135 0.02% w/v	150	35	31	46
	250	66	87	58
	350	78	99	80
Formulation C + Fluorad FC-170C 0.02% w/v	150	29	68	41
	250	54	78	61
	350	59	86	78
Formulation C + Fluorad FC-171 0.02% w/v	150	20	96	35
	250	37	99	62
	350	55	100	65

Spray composition	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Formulation C + Fluorad FC-431 0.02% w/v	150	20	94	41
	250	51	85	68
	350	66	97	74
Formulation C + Fluorad FC-751 0.02% w/v	150	15	67	38
	250	36	85	56
	350	60	100	72
Formulation C + Fluorad FC-754 0.02% w/v	150	33	78	37
	250	75	85	66
	350	82	94	80
32-01	150	25	35	45
	250	43	52	63
	350	60	90	77
32-02	150	65	37	58
	250	69	69	67
	350	66	69	78
32-03	150	14	40	41
	250	45	78	63
	350	55	92	75
32-04	150	19	48	48
	250	36	51	63
	350	65	69	70
32-05	150	47	34	45
	250	55	43	55
	350	63	58	75
32-06	150	23	36	46
	250	57	52	59
	350	61	73	67
32-07	150	67	59	58
	250	81	73	72
	350	80	76	76
32-08	150	37	49	60
	250	60	83	69
	350	67	93	49
32-09	150	19	63	51
	250	53	71	62
	350	55	74	82
32-10	150	19	70	51
	250	39	94	61
	350	63	87	73
32-11	150	16	51	50
	250	58	67	66
	350	69	92	73

Composition 32-07, containing 0.02% lecithin and 0.02% Fluorad FC-754, was equal or superior to composition 32-02, containing 0.02% lecithin and 0.02% Fluorad FC-135, in herbicidal effectiveness. This indicates that Fluorad FC-754 is an acceptable substitute for Fluorad FC-135 in such compositions.

The other fluoro-organic surfactants tested in this Example, none of which is cationic, were less effective than the cationic fluoro-organics Fluorad FC-135 and Fluorad FC-754 as excipients in combination with lecithin. A possible exception was Fluorad FC-170C which gave good enhancement of glyphosate effectiveness on ECHCF only.

EXAMPLE 33

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 33a. Process (v) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of all compositions was approximately 5.

Table 33a

Concentrate composition	% w/w				
	Glyphosate a.e.	Lecithin	MON 0818	Agrimul PG-2069	Fluorad FC-135
33-01	30	3.0		0.25	3.0
33-02	30	3.0		0.25	1.0
33-03	30	3.0	0.25		3.0
33-04	30	1.0	0.50		3.0
33-05	30	1.0		0.50	3.0
33-06	30	1.0			1.0
33-07	30	1.0		0.25	1.0
33-08	30	3.0		0.50	2.0
33-09	30	2.0			3.0
33-10	30	3.0	0.50		

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH and 17 days after planting ECHCF, and evaluation of herbicidal inhibition was done 19 days after application.

Formulations C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 33b.

Table 33b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation C	56	3	5
	112	49	48
	224	79	83
	448	99	99
Formulation J	56	16	20
	112	40	43
	224	80	81
	448	97	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
33-01	56	4	5
	112	35	20
	224	81	51
	448	99	80
33-02	56	0	5
	112	4	20
	224	66	55
	448	94	80
33-03	56	1	5
	112	6	20
	224	78	74
	448	93	80
33-04	56	1	5
	112	1	15
	224	75	65
	448	95	80
33-05	56	0	5
	112	1	15
	224	75	65
	448	91	80
33-06	56	0	5
	112	3	15
	224	55	63
	448	91	79
33-07	56	1	5
	112	3	15
	224	48	55
	448	88	81
33-08	56	3	9
	112	3	20
	224	66	60
	448	89	80
33-09	56	0	5
	112	5	10
	224	78	55
	448	97	80
33-10	56	0	5
	112	4	15
	224	21	55
	448	88	79

Concentrate compositions containing lecithin and Fluorad FC-135 did not exhibit herbicidal effectiveness superior to commercial standard Formulations C and J in this test.

EXAMPLE 34

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 34a. Process (iii) was followed for all compositions, using soybean

lecithin (20% phospholipid, Avanti). The pH of all compositions was adjusted to approximately 7.

Table 34a

Spray composition	Lecithin g/l	% w/w Fluorad FC-135
34-01	0.25	
34-02	0.05	
34-03	0.02	
34-04	0.01	
34-05	0.25	0.25
34-06	0.05	0.05
34-07	0.02	0.02
34-08	0.01	0.01

Guineagrass (Panicum maximum, PANMA) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 78 days after planting PANMA, and evaluation of herbicidal inhibition was done 20 days after application.

In addition to compositions 34-01 to 34-08, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 at various concentrations. Formulations B and C alone were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 34b.

Table 34b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition PANMA
Formulation B	400	61
	800	89
	1500	93
	2000	97
Formulation C	400	85
	800	94
	1500	100
	2000	100
Formulation B + Fluorad FC-135 0.25% w/v	400	76
	800	78
	1500	97
Formulation B + Fluorad FC-135 0.05% w/v	400	45
	800	69
	1500	89
Formulation B + Fluorad FC-135 0.02% w/v	400	39
	800	71
	1500	95
Formulation B + Fluorad FC-135 0.01% w/v	400	52
	800	78
	1500	99
Formulation C + Fluorad FC-135 0.25% w/v	400	82
	800	97
	1500	100

Spray composition	Glyphosate rate g a.e./ha	% Inhibition PANMA
Formulation C + Fluorad FC-135 0.05% w/v	400	63
	800	93
	1500	100
Formulation C + Fluorad FC-135 0.02% w/v	400	73
	800	98
	1500	100
Formulation C + Fluorad FC-135 0.01% w/v	400	66
	800	97
	1500	100
34-01	400	38
	800	73
	1500	92
34-02	400	64
	800	83
	1500	90
34-03	400	50
	800	75
	1500	99
34-04	400	48
	800	88
	1500	98
34-05	400	60
	800	79
	1500	99
34-06	400	58
	800	86
	1500	99
34-07	400	55
	800	86
	1500	93
34-08	400	60
	800	91
	1500	98

Exceptionally high glyphosate activity was seen in this test even with Formulation B and no firm conclusions can be drawn. However, none of the compositions containing lecithin and Fluorad FC-135 exceeded the effectiveness of commercial standard Formulation C on PANMA under the conditions of this test.

EXAMPLE 35

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 35a. Process (v) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of all compositions was approximately 5.

Table 35a

Concentrate composition	% w/w					
	Glyphosate a.e.	Lecithin	Fluorad FC-135	Fluorad FC-754	MON 0818	Agrimul PG-2069
35-01	30	3.0	3.0			0.25
35-02	30	3.0	1.0			0.25
35-03	30	3.0	3.0		0.25	
35-04	30	1.0	3.0		0.50	
35-05	30	1.0	3.0			0.50
35-06	30	1.0	1.0			
35-07	30	1.0	1.0			0.25
35-08	30	3.0	2.0			0.50
35-09	30	2.0	3.0			
35-10	30	3.0			0.50	
35-11	30	3.0		3.0		0.50
35-12	30	2.0		1.0		0.375
35-13	30	1.0		2.0		0.25
35-14	30	3.0		3.0	0.50	
35-15	30	3.0		3.0		0.50
35-16	30	2.0		1.0		0.375
35-17	30	1.0		2.0		0.25
35-18	30	3.0		3.0	0.50	

Quackgrass (Elymus repens, AGRRE) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 56 days after planting AGRRE, and evaluation of herbicidal inhibition was done 16 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 35b.

Table 35b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition AGRRE
Formulation B	400	41
	800	46
	1000	55
	1200	70
Formulation C	400	38
	800	47
	1000	77
	1200	77
Formulation J	400	60
	800	84
	1000	77
	1200	85
35-01	400	27
	800	76
	1000	79
35-02	400	49

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition AGRRE
	800	66
	1000	78
35-03	400	42
	800	80
	1000	83
35-04	400	31
	800	71
	1000	64
35-05	400	32
	800	53
	1000	59
35-06	400	27
	800	39
	1000	65
35-07	400	29
	800	54
	1000	61
35-08	400	38
	800	65
	1000	81
35-09	400	31
	800	55
	1000	67
35-10	400	43
	800	38
	1000	58
35-11	400	34
	800	56
	1000	75
35-12	400	29
	800	51
	1000	65
35-13	400	51
	800	69
	1000	83
35-14	400	39
	800	63
	1000	65
35-15	400	53
	800	65
	1000	77
35-16	400	43
	800	65
	1000	82
35-17	400	69
	800	84
	1000	94

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition AGRRE
35-18	400	69
	800	92
	1000	92

Compositions of the invention exhibiting superior herbicidal effectiveness to commercial standard Formulation C in this test on AGRRE included 35-01, 35-02, 35-03, 35-13 and 35-15 to 35-18. Compositions 35-17 and 35-18 were the most effective in this test, outperforming commercial standard Formulation J as well as Formulation C.

EXAMPLE 36

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 36a. Process (v) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The order of addition of ingredients was varied in compositions 36-15 to 36-20 as shown below. The pH of all compositions was approximately 5.

Table 36a

Conc. comp.	% w/w					Lecithin phospho-lipid %	order of addition (*)
	Glyphosate a.e.	Lecithin	Fluorad FC-135	Agrimul PG-2069	MON 0818		
36-01	30	3.0	2.0	0.50		45	A
36-02	30	3.0	3.0	0.50		45	A
36-03	30	3.0	3.0	0.75		45	A
36-04	30	3.0	3.0	0.75	0.5	45	A(**)
36-05	30	3.0	3.0	1.00		45	A
36-06	30	3.0	3.0	2.00		45	A
36-07	30	3.0	3.0	3.00		45	A
36-08	30	3.0	3.0	4.00		45	A
36-09	30	3.0	2.0	0.50		20	A
36-10	30	3.0	2.0	0.50		20	B
36-11	30	3.0	2.0	0.50		20	C
36-12	30	3.0	2.0	0.50		20	D
36-13	30	3.0	2.0	0.50		20	E
36-14	30	3.0	2.0	0.50		20	F
36-15	30	3.0	3.0	0.50		20	A
36-16	30	3.0	3.0	0.50		20	B
36-17	30	3.0	3.0	0.50		20	C
36-18	30	3.0	3.0	0.50		20	D
36-19	30	3.0	3.0	0.50		20	E
36-20	30	3.0	3.0	0.50		20	F

(*) Order of addition:

	1st	2nd	3rd	4th	5th
A	lecithin	PG-2069	FC-135	water	glyphosate
B	lecithin	FC-135	PG-2069	water	glyphosate
C	glyphosate	water	FC-135	PG-2069	lecithin
D	glyphosate	water	PG-2069	FC-135	lecithin
E	glyphosate	lecithin	PG-2069	FC-135	water
F	glyphosate	lecithin	FC-135	PG-2069	water

(**) where MON 0818 included, added with Agrimul PG-2069

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 19 days after planting ABUTH and 22 days after planting ECHCF, and evaluation of herbicidal inhibition was done 17 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 36b.

Table 36b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	200	38	73
	400	51	64
	600	67	89
	800	72	86
Formulation C	200	57	75
	400	77	98
	600	92	97
	800	100	100
Formulation J	200	50	52
	400	73	99
	600	88	99
	800	98	98
36-01	200	49	64
	400	72	59
	600	78	87
36-02	200	54	72
	400	78	71
	600	97	90
36-03	200	57	62
	400	80	78
	600	89	87
36-04	200	46	39
	400	74	64
	600	86	78
36-05	200	49	29
	400	74	79
	600	83	90

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
36-06	200	49	65
	400	70	88
	600	87	88
36-07	200	49	51
	400	67	77
	600	81	83
36-08	200	42	59
	400	70	67
	600	78	80
36-09	200	45	28
	400	73	85
	600	87	98
36-10	200	57	82
	400	76	89
	600	87	98
36-11	200	56	80
	400	84	84
	600	85	100
36-12	200	57	81
	400	78	98
	600	87	94
36-13	200	54	86
	400	73	72
	600	96	97
36-14	200	56	73
	400	69	98
	600	85	94
36-15	200	40	41
	400	85	88
	600	83	96
36-16	200	53	59
	400	73	76
	600	84	73
36-17	200	39	53
	400	65	86
	600	86	81
36-18	200	49	31
	400	69	52
	600	73	75
36-19	200	47	50
	400	74	86
	600	88	98
36-20	200	51	42
	400	68	94
	600	90	98

Order of addition of ingredients apparently had some influence on herbicidal effectiveness of compositions 36-09 to 36-20. However, as most of these compositions showed poor short-term stability, it is likely that in at least some cases the uniformity of spray application was affected and the results are therefore difficult to interpret.

EXAMPLE 37

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 37a. Process (iv) was followed for all compositions, using soybean lecithin (20% phospholipid, Avanti). The pH of all compositions was approximately 5.

Table 37a

Concentrate composition	Glyphosate g a.e./l	% w/w					
		Lecithin	Aerosol OT	MON 0818	Fluorad FC-754	Methyl caprate	PVA
37-01	200	2.0		0.25			
37-02	300	3.0		0.50			
37-03	300	3.0		0.50			2.0
37-04	200	2.0		0.25			1.5
37-05	200	2.0		0.25		1.0	1.0
37-06	200	2.0		0.25		1.0	1.0
37-07	200	2.0		0.25	2.0		
37-08	200		2.0	0.25			
37-09	300		3.0	0.50			
37-10	300		3.0	0.50			2.0
37-11	200		2.0	0.25			1.5
37-12	200		2.0	0.25		1.0	
37-13	200		2.0	0.25		1.0	
37-14	200		2.0	0.25		1.0	1.5
37-15	200		2.0	0.25	2.0		

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and 13 days after planting ECHCF, and evaluation of herbicidal inhibition was done 20 days after application.

Compositions containing PVA were too viscous to spray and were not tested for herbicidal effectiveness. Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 37b.

Table 37b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	112	5	4
	224	48	8
	336	73	20
	448	94	50

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation C	112	30	45
	224	91	81
	336	98	81
	448	100	99
Formulation J	112	50	35
	224	80	65
	336	97	88
	448	100	90
37-01	112	11	8
	224	50	40
	336	71	61
	448	93	78
37-02	112	5	6
	224	64	58
	336	78	60
	448	84	65
37-07	112	5	3
	224	46	38
	336	73	83
	448	93	66
37-08	112	8	13
	224	43	46
	336	73	65
	448	83	70
37-09	112	1	5
	224	23	25
	336	65	33
	448	91	58
37-12	112	0	5
	224	58	48
	336	73	63
	448	91	63
37-13	112	0	10
	224	53	38
	336	73	45
	448	88	50
37-15	112	28	10
	224	50	53
	336	80	63
	448	88	91

Concentrate compositions containing lecithin and Fluorad FC-754 or methyl caprate did not exhibit herbicidal effectiveness equal to that of the commercial standards in this test.

EXAMPLE 38

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 38a. Process (iii) was followed for all compositions, using soybean

lecithin (20% phospholipid, Avanti). The pH of all compositions was approximately 5.

Table 38a

Concentrate composition	% w/w			
	Glyphosate a.e.	Lecithin	Fluorad FC-135	MON 0818
38-01	30	3.0	3.0	0.75
38-02	25	2.5	2.5	0.63
38-03	20	2.0	2.0	0.50
38-04	15	1.5	1.5	0.38
38-05	10	1.0	1.0	0.25
38-06	5	0.5	0.5	0.13
38-07	30	3.0	3.0	1.50
38-08	25	2.5	2.5	0.63
38-09	20	2.0	2.0	0.50
38-10	15	1.5	1.5	0.38
38-11	10	1.0	1.0	0.25
38-12	5	0.5	0.5	0.13
38-13	25	2.5	2.5	0.94
38-14	20	2.0	2.0	0.75
38-15	15	1.5	1.5	0.56
38-16	10	1.0	1.0	0.38
38-17	5	0.5	0.5	0.19

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 19 days after planting ABUTH and 21 days after planting ECHCF, and evaluation of herbicidal inhibition was done 14 days after application.

In addition to compositions 38-01 to 38-17, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 at two concentrations. Formulations B and C alone were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 38b.

Table 38b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation C	200	59	98
	400	96	96
	600	70	93
	800	100	97
Formulation C + Fluorad FC-135 0.1%	200	59	92
	400	93	93
	600	95	100
	800	100	97

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation C + Fluorad FC-135 0.05%	200	54	73
	400	95	76
	600	100	82
	800	100	95
Formulation J	200	55	87
	400	92	98
	600	97	94
	800	99	96
Formulation J + Fluorad FC-135 0.1%	200	67	88
	400	89	89
	600	94	87
	800	96	91
Formulation J + Fluorad FC-135 0.05%	200	71	81
	400	75	95
	600	96	99
	800	100	100
38-01	200	53	71
	400	74	87
	600	98	87
38-02	200	51	70
	400	88	96
	600	89	99
38-03	200	51	85
	400	81	97
	600	96	94
38-04	200	51	63
	400	81	82
	600	96	97
38-05	200	47	60
	400	73	91
	600	94	94
38-06	200	54	43
	400	73	88
	600	92	87
38-07	200	60	70
	400	84	93
	600	90	98
38-08	200	49	55
	400	76	92
	600	88	83
38-09	200	57	53
	400	79	95
	600	91	87
38-10	200	55	85
	400	90	97
	600	94	96

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
38-11	200	64	43
	400	77	87
	600	93	96
38-12	200	54	72
	400	85	98
	600	96	100
38-13	200	61	61
	400	84	90
	600	95	99
38-14	200	57	86
	400	82	90
	600	99	98
38-15	200	59	89
	400	78	96
	600	93	97
38-16	200	53	87
	400	81	98
	600	96	98
38-17	200	48	87
	400	81	100
	600	91	100

As concentrate compositions in previous Examples have tended to exhibit weaker herbicidal effectiveness than has been seen with ready-made spray compositions, this test was conducted to determine if the degree of concentration at which a composition is prepared before dilution for spraying had an influence on effectiveness. No consistent trend was seen in this test.

EXAMPLE 39

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 39a. Process (iii) was followed for all compositions, using soybean lecithin (45% phospholipid, Avanti). The pH of all compositions was approximately 5.

Table 39a

Conc. comp.	% w/w				Type of amine surfactant
	Glyphosate a.e.	Lecithin	Fluorad FC-135 or FC-754	Amine surfactant	
39-01	20	2.0		0.25	MON 0818
39-02	20	3.0		0.25	MON 0818
39-03	20	3.0	3.0 (135)	0.25	MON 0818
39-04	20	3.0	3.0 (754)	0.25	MON 0818
39-05	20	2.0		2.00	Triton RW-20
39-06	20	2.0		2.00	Triton RW-50
39-07	20	2.0		2.00	Triton RW-75
39-08	20	2.0		2.00	Triton RW-100
39-09	20	2.0		2.00	Triton RW-150
39-10	20			2.00	Triton RW-20

Conc. comp.	% w/w				Type of amine surfactant
	Glyphosate a.e.	Lecithin	Fluorad FC-135 or FC-754	Amine surfactant	
39-11	20			2.00	Triton RW-50
39-12	20			2.00	Triton RW-75
39-13	20			2.00	Triton RW-100
39-14	20			2.00	Triton RW-150

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH and 17 days after planting ECHCF, and evaluation of herbicidal inhibition was done 21 days after application.

Formulation C was applied as a comparative treatment. Results, averaged for all replicates of each treatment, are shown in Table 39b.

Table 39b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation C	112	0	10
	224	10	20
	336	47	30
	448	63	40
39-01	112	8	15
	224	25	35
	336	55	56
	448	63	65
39-02	112	5	10
	224	23	33
	336	55	64
	448	66	60
39-03	112	28	15
	224	55	35
	336	74	58
	448	76	65
39-04	112	15	8
	224	53	45
	336	73	55
	448	75	64
39-05	112	0	8
	224	14	45
	336	45	70
	448	65	66
39-06	112	1	13
	224	5	43
	336	58	64
	448	66	75

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
39-07	112	0	15
	224	1	53
	336	45	78
	448	60	83
39-08	112	0	10
	224	25	45
	336	50	79
	448	68	88
39-09	112	0	13
	224	13	45
	336	50	75
	448	70	81
39-10	112	0	18
	224	18	35
	336	48	65
	448	66	76
39-11	112	1	0
	224	35	25
	336	38	55
	448	50	78
39-12	112	8	25
	224	10	38
	336	48	70
	448	73	81
39-13	112	0	25
	224	5	33
	336	30	70
	448	74	75
39-14	112	0	12
	224	0	30
	336	12	70
	448	40	80

No difference in herbicidal effectiveness was seen between compositions 39-03 and 39-04. The only difference between these compositions is that 39-03 contained Fluorad FC-135 and 39-04 contained Fluorad FC-754.

EXAMPLE 40

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 40a. Process (iii) was followed for all compositions, using soybean lecithin (20% or 45% phospholipid as indicated below. both sourced from Avanti). The pH of all compositions was adjusted to approximately 7.

Table 40a

Spray composition	Lecithin g/l	Lecithin % purity	% w/w	
			Fluorad FC-135	Fluorad FC-754
40-01	1.0	20		
40-02	0.5	20		
40-03	0.2	20		
40-04	1.0	20	0.10	
40-05	0.5	20	0.05	
40-06	0.2	20	0.02	
40-07	1.0	20		0.10
40-08	0.5	20		0.05
40-09	0.2	20	0.02	0.02
40-10	0.5	45	0.05	
40-11	0.5	45		0.05

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 18 days after planting ABUTH and 21 days after planting ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

In addition to compositions 40-01 to 40-11, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 or FC-754 at various concentrations. Formulations B and C alone were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 40b.

Table 40b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	49	100
	300	66	92
	500	80	76
	700	93	96
Formulation C	200	57	79
	400	93	98
	600	100	100
	800	100	100
Formulation B + Fluorad FC-135 0.1%	200	58	80
	400	63	100
	600	82	100
Formulation B + Fluorad FC-135 0.05%	200	37	49
	400	67	84
	600	74	100
Formulation B + Fluorad FC-135 0.02%	200	33	82
	400	58	94
	600	81	87

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B + Fluorad FC-754 0.1%	200	50	45
	400	77	82
	600	77	94
Formulation B + Fluorad FC-754 0.05%	200	44	45
	400	71	65
	600	74	90
Formulation B + Fluorad FC-754 0.02%	200	31	57
	400	67	83
	600	68	93
Formulation C + Fluorad FC-135 0.1%	200	69	65
	400	91	99
	600	97	100
Formulation C + Fluorad FC-135 0.05%	200	73	87
	400	89	100
	600	98	100
Formulation C + Fluorad FC-135 0.02%	200	51	60
	400	91	100
	600	98	100
Formulation C + Fluorad FC-754 0.1%	200	70	81
	400	85	99
	600	98	95
Formulation C + Fluorad FC-754 0.05%	200	68	54
	400	78	88
	600	91	88
Formulation C + Fluorad FC-754 0.02%	200	50	41
	400	89	91
	600	99	100
40-01	200	41	37
	400	78	84
	600	83	100
40-02	200	38	82
	400	74	94
	600	82	98
40-03	200	38	62
	400	69	85
	600	86	100
40-04	200	63	69
	400	79	75
	600	93	89
40-05	200	69	66
	400	85	81
	600	84	86
40-06	200	64	38
	400	79	74
	600	93	99
40-07	200	61	43
	400	76	71
	600	85	85

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
40-08	200	71	52
	400	82	85
	600	82	100
40-09	200	63	55
	400	83	73
	600	79	97
40-10	200	65	54
	400	78	80
	600	85	99
40-11	200	55	33
	400	77	74
	600	91	97

There was a tendency, although not consistently so, for compositions of this Example containing Fluorad FC-754 to show slightly weaker herbicidal effectiveness than corresponding compositions containing Fluorad FC-135.

EXAMPLE 41

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 41a. Process (v) was followed for all compositions, using soybean lecithin (45% phospholipid, Avanti). The pH of all compositions was approximately 5.

Table 41a

Concentrate composition	% w/w				
	Glyphosate a.e.	Lecithin	Fluorad FC-135	Fluorad FC-754	MON 0818
41-01	15.0	4.0	8.0		0.5
41-02	15.0	6.0	8.0		0.5
41-03	15.0	8.0	8.0		0.5
41-04	10.0	4.0	8.0		0.5
41-05	10.0	6.0	8.0		0.5
41-06	10.0	8.0	8.0		0.5
41-07	5.0	4.0	8.0		0.5
41-08	5.0	6.0	8.0		0.5
41-09	5.0	8.0	8.0		0.5
41-10	15.0	4.0		8.0	0.5
41-11	15.0	6.0		8.0	0.5
41-12	15.0	8.0		8.0	0.5
41-13	10.0	4.0		8.0	0.5
41-14	10.0	6.0		8.0	0.5
41-15	10.0	8.0		8.0	0.5
41-16	5.0	4.0		8.0	0.5
41-17	5.0	6.0		8.0	0.5
41-18	5.0	8.0		8.0	0.5

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 18 days after planting ABUTH and 20 days after planting ECHCF, and evaluation of herbicidal inhibition was done 15 days after application.

In addition to compositions 41-01 to 41-18, spray compositions were prepared by tank mixing Formulations B and J with Fluorad FC-135 at two concentrations. Formulations B and J alone were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 41b.

Table 41b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	49	41
	300	41	55
	500	76	98
	700	82	100
Formulation J	150	59	66
	300	79	99
	500	93	99
	700	98	100
Formulation B + Fluorad FC-135 0.1%	150	52	85
	300	69	93
	500	89	97
Formulation B + Fluorad FC-135 0.05%	150	9	61
	300	71	77
	500	77	100
Formulation J + Fluorad FC-135 0.1%	150	52	99
	300	74	100
	500	82	99
Formulation J + Fluorad FC-135 0.05%	150	41	52
	300	77	83
	500	91	100
41-01	150	66	51
	300	86	91
	500	93	100
41-02	150	72	88
	300	89	93
	500	96	92
41-03	150	71	91
	300	89	95
	500	91	100
41-04	150	63	90
	300	89	89
	500	96	99
41-05	150	70	79
	300	84	94
	500	88	98

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
41-06	150	69	76
	300	89	84
	500	94	100
41-07	150	71	87
	300	77	82
	500	99	92
41-08	150	81	87
	300	88	94
	500	92	98
41-09	150	72	83
	300	87	83
	500	94	94
41-10	150	72	70
	300	81	80
	500	89	93
41-11	150	74	85
	300	87	96
	500	91	98
41-12	150	66	92
	300	78	98
	500	93	100
41-13	150	71	76
	300	86	95
	500	94	99
41-14	150	72	75
	300	90	97
	500	91	99
41-15	150	69	82
	300	85	98
	500	94	100
41-16	150	76	87
	300	86	100
	500	90	99
41-17	150	71	83
	300	87	94
	500	96	100
41-18	150	70	81
	300	77	98
	500	89	98

Good herbicidal effectiveness was obtained with the concentrate compositions of this Example containing lecithin and Fluorad FC-135 or Fluorad FC-754. No great or consistent difference was seen between compositions containing Fluorad FC-135 and their counterparts containing Fluorad FC-754.

EXAMPLE 42

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient

ingredients as shown in Table 42a. Process (v) was followed for all compositions, using soybean lecithin (95% phospholipid, Avanti). The pH of all compositions was approximately 5.

Table 42a

Conc. comp.	% w/w						
	Glyphosate a.e.	Lecithin	MON 0818	Agrimul PG-2069	Fluorad FC-135	Fluorad FC-754	Westvaco H-240
42-01	30	3.0		0.25	3.0		9.0
42-02	30	3.0		0.25	1.0		9.0
42-03	30	3.0	0.25		3.0		9.0
42-04	30	1.0	0.50		3.0		9.0
42-05	30	1.0		0.50	3.0		9.0
42-06	30	1.0			1.0		9.0
42-07	30	1.0		0.25	1.0		9.0
42-08	30	3.0		0.50	2.0		9.0
42-09	30	2.0			3.0		9.0
42-10	30	3.0					5.0
42-11	30	3.0		0.50		3.0	9.0
42-12	30	2.0		0.38		2.0	9.0
42-13	30	1.0		0.25		1.0	9.0
42-14	30	3.0	0.50			3.0	9.0
42-15	15	6.0	2.00		8.3		
42-16	15	6.0	4.00		8.3		

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and 20 days after planting ECHCF, and evaluation of herbicidal inhibition was done 15 days after application.

In addition to compositions 42-01 to 42-16, spray compositions were prepared by tank mixing Formulations B and J with Fluorad FC-135 at two concentrations. Formulations B and J alone were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 42b.

Table 42b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	3	33
	300	12	90
	500	65	98
	700	79	100
Formulation J	150	2	46
	300	76	100
	500	98	100
	700	98	100
Formulation B + Fluorad FC-135 0.1%	150	10	38
	300	50	85
	500	65	68

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B + Fluorad FC-135 0.05%	150	3	27
	300	36	82
	500	68	99
Formulation J + Fluorad FC-135 0.1%	150	18	79
	300	57	98
	500	79	100
Formulation J + Fluorad FC-135 0.05%	150	2	37
	300	56	97
	500	96	98
42-01	150	2	27
	300	2	74
	500	46	78
42-02	150	2	52
	300	41	64
	500	40	85
42-03	150	3	38
	300	39	47
	500	73	98
42-04	150	3	38
	300	42	63
	500	78	84
42-05	150	5	29
	300	37	89
	500	70	99
42-06	150	8	37
	300	30	89
	500	69	97
42-07	150	5	53
	300	32	80
	500	83	99
42-08	150	3	26
	300	10	40
	500	12	55
42-09	150	7	21
	300	57	86
	500	91	97
42-10	150	21	61
	300	73	89
	500	85	98
42-11	150	6	23
	300	53	70
	500	85	83
42-12	150	33	25
	300	34	43
	500	83	97
42-13	150	7	34
	300	62	39
	500	77	73

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
42-14	150	10	27
	300	59	40
	500	84	73
42-15	150	71	48
	300	97	65
	500	99	92
42-16	150	83	40
	300	98	89
	500	100	95

The only concentrate compositions in this test exhibiting excellent performance, at least on ABUTH, were 42-15 and 42-16.

EXAMPLE 43

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 43a. Process (viii) was followed for composition 43-02 and process (ix) for compositions 43-03 to 43-13 which contain a colloidal particulate together with surfactant. Composition 43-01 contains colloidal particulate but no surfactant. The pH of all compositions was approximately 5.

Table 43a

Concentrate composition	% w/w			
	Glyphosate a.e.	Fluorad FC-135	Aerosil 90	Emphos PS-21A
43-01	20		3.3	
43-02	20	3.3		
43-03	31	1.1	3.3	1.1
43-04	31	1.1	3.3	2.2
43-05	31	1.1	3.3	3.3
43-06	31	2.2	3.3	1.1
43-07	31	2.2	3.3	2.2
43-08	31	2.2	3.3	3.3
43-09	31	3.3	3.3	1.1
43-10	31	3.3	3.3	2.2
43-11	31	3.3	3.3	3.3
43-12	31	3.3	3.3	
43-13	31		3.3	3.3

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH and 17 days after planting ECHCF, and evaluation of herbicidal inhibition was done 23 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all

replicates of each treatment, are shown in Table 43b.

Table 43b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	8
	250	18	25
	350	35	40
	450	75	50
Formulation C	150	30	85
	250	92	95
	350	100	100
	450	100	100
Formulation J	150	40	70
	250	70	83
	350	93	92
	450	100	98
43-01	150	20	25
	250	35	30
	350	65	43
	450	73	35
43-02	150	5	5
	250	20	25
	350	45	35
	450	66	83
43-03	150	20	11
	250	40	30
	350	73	64
	450	88	83
43-04	150	15	3
	250	30	25
	350	40	35
	450	71	75
43-05	150	15	10
	250	33	30
	350	69	45
	450	78	65
43-06	150	11	8
	250	28	30
	350	30	35
	450	69	61
43-07	150	5	8
	250	13	20
	350	51	30
	450	74	43
43-08	150	15	8
	250	30	15
	350	35	30
	450	56	45

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
43-09	150	15	15
	250	28	20
	350	43	33
	450	45	40
43-10	150	5	3
	250	25	20
	350	50	40
	450	48	58
43-11	150	14	6
	250	25	40
	350	64	76
	450	78	79
43-12	150	9	20
	250	20	33
	350	46	73
	450	59	80
43-13	150	15	11
	250	20	28
	350	30	59
	450	68	48

Most concentrate compositions containing Fluorad FC-135 showed enhanced herbicidal effectiveness by comparison with Formulation B but did not equal the performance of commercial standard Formulations C and J under the conditions of this test.

EXAMPLE 44

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 44a. Process (viii) was followed for compositions 44-01, 44-03, 44-06, 44-07, 44-10, 44-14, 44-15, 44-18 and 44-19 and process (ix) for compositions 44-02, 44-08, 44-09, 44-16 and 44-17 which contain a colloidal particulate together with surfactant. Compositions 44-04, 44-05, 44-12 and 44-13 contain colloidal particulate but no surfactant. The pH of all compositions was approximately 5.

Table 44a

Concentrate composition	% w/w					
	Glyphosate a.e.	Fluorad FC-135	Ethomeen T/25	Aluminum oxide C	Titanium dioxide P25	Aerosol OT
44-01	20		3.30			
44-02	20					3.30
44-03	20	3.30				
44-04	20			3.30		
44-05	20			0.67		
44-06	20		3.30	3.30		
44-07	20		3.30	0.67		
44-08	20			3.30		3.30

Concentrate composition	% w/w					
	Glyphosate a.e.	Fluorad FC-135	Ethomeen T/25	Aluminum oxide C	Titanium dioxide P25	Aerosol OT
44-09	20			0.67		3.30
44-10	20	3.30		3.30		
44-11	20	3.30		0.67		
44-12	20				3.30	
44-13	20				0.67	
44-14	20		3.30		3.30	
44-15	20		3.30		0.67	
44-16	20				3.30	3.30
44-17	20				0.67	3.30
44-18	20	3.30			3.30	
44-19	20	3.30			0.67	

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 18 days after planting ABUTH and 20 days after planting ECHCF, and evaluation of herbicidal inhibition was done 25 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 44b.

Table 44b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	8	45
	250	37	55
	350	40	60
	450	50	70
Formulation C	150	27	72
	250	73	92
	350	90	99
	450	92	99
Formulation J	150	25	66
	250	45	88
	350	78	99
	450	91	100
44-01	150	40	82
	250	55	93
	350	74	100
	450	83	100
44-02	150	9	20
	250	30	73
	350	38	73
	450	55	97

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
44-03	150	13	23
	250	35	79
	350	45	78
	450	75	100
44-04	150	18	45
	250	35	65
	350	35	70
	450	68	81
44-05	150	11	43
	250	35	50
	350	50	55
	450	59	78
44-06	150	25	75
	250	58	93
	350	88	100
	450	95	100
44-07	150	15	88
	250	68	100
	350	79	100
	450	90	100
44-08	150	28	38
	250	25	38
	350	35	55
	450	71	79
44-09	112	5	13
	224	23	48
	336	25	70
	448	45	64
44-10	150	1	20
	250	40	74
	350	65	55
	450	84	96
44-11	150	25	25
	250	35	65
	350	45	61
	450	76	92
44-12	150	14	28
	250	40	43
	350	45	70
	450	65	79
44-13	150	20	45
	250	48	33
	350	60	55
	450	80	79
44-14	150	23	79
	250	73	100
	350	76	99
	450	85	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
44-15	150	25	83
	250	69	99
	350	75	99
	450	91	100
44-16	150	14	28
	250	23	40
	350	30	79
	450	69	86
44-17	150	1	20
	250	23	33
	350	16	45
	450	40	68
44-18	150	8	15
	250	49	56
	350	55	58
	450	83	83
44-19	150	6	15
	250	35	60
	350	61	63
	450	63	70

Concentrate compositions containing Fluorad FC-135 showed enhanced herbicidal effectiveness by comparison with Formulation B but did not provide herbicidal effectiveness equal to commercial standard Formulations C and J in this test.

EXAMPLE 45

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 45a. Process (i) was followed for compositions 45-10 to 45-12 and process (iii) for compositions 45-01 to 45-09 using soybean lecithin (45% phospholipid, Avanti). The pH of all compositions was adjusted to approximately 7.

Table 45a

Spray composition	% w/w		
	Lecithin	Fluorad FC-135	Surf H1
45-01	0.10		
45-02	0.05		
45-03	0.02		
45-04	0.10	0.10	
45-05	0.05	0.05	
45-06	0.02	0.02	
45-07	0.10		0.10
45-08	0.05		0.05
45-09	0.02		0.02
45-10			0.10
45-11			0.05
45-12			0.02

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 23 days after planting ABUTH and 21 days after planting ECHCF, and evaluation of herbicidal inhibition was done 15 days after application.

In addition to compositions 45-01 to 45-12, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 at various concentrations. Formulations B and C alone and Formulation J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 45b.

Table 45b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	16	21
	250	68	32
	350	68	63
	450	67	69
Formulation C	150	29	47
	250	76	74
	350	98	94
	450	100	85
Formulation J	150	37	31
	250	79	72
	350	93	82
	450	97	97
Formulation B + Fluorad FC-135 0.1% w/v	150	55	15
	250	73	28
	350	85	57
	450	83	83
Formulation B + Fluorad FC-135 0.05% w/v	150	59	15
	250	77	41
	350	81	72
	450	77	51
Formulation B + Fluorad FC-135 0.02% w/v	150	25	12
	250	54	27
	350	82	38
	450	75	47
Formulation C + Fluorad FC-135 0.1% w/v	150	51	26
	250	78	63
	350	86	71
	450	89	79
Formulation C + Fluorad FC-135 0.05% w/v	150	58	23
	250	74	89
	350	93	78
	450	89	91

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
45-01	150	29	26
	250	61	47
	350	73	48
	450	82	62
45-02	150	34	34
	250	67	34
	350	73	54
	450	85	43
45-03	150	20	29
	250	60	49
	350	68	84
	450	74	64
45-04	150	78	24
	250	83	33
	350	96	64
	450	97	59
45-05	150	81	21
	250	89	27
	350	82	34
	450	99	31
45-06	150	92	14
	250	85	64
	350	86	31
	450	90	60
45-07	150	71	27
	250	81	46
	350	84	66
	450	88	62
45-08	150	46	29
	250	70	43
	350	78	61
	450	86	58
45-09	150	55	25
	250	76	33
	350	80	50
	450	78	62
45-10	150	65	26
	250	85	28
	350	91	37
	450	89	53
45-11	150	73	27
	250	77	28
	350	92	41
	450	92	49
45-12	150	71	20
	250	74	31
	350	79	39
	450	93	53

Extremely high herbicidal effectiveness was noted on ABUTH with compositions 45-04 to 45-06, containing lecithin and Fluorad FC-135. Replacement of Fluorad FC-135 by "Surf H1", a hydrocarbon-based surfactant of formula $C_{12}H_{25}SO_2NH(CH_2)_3N^+(CH_3)_3\ I^-$, gave (in compositions 45-07 to 45-09) effectiveness on ABUTH still superior at low glyphosate rates to commercial standard Formulations C and J but not quite as great as that of compositions 45-04 to 45-06. Performance of compositions 45-04 to 45-12 on ECHCF was relatively low in this test but performance on ABUTH was remarkably high considering the very low surfactant concentrations present.

EXAMPLE 46

Aqueous spray compositions were prepared containing glyphosate IPA or tetrabutylammonium salt and excipient ingredients as shown in Table 46a. Process (i) was followed for compositions 46-10 to 46-13 and 46-15 and process (iii) for compositions 46-01 to 46-09 using soybean lecithin (45% phospholipid, Avanti). The pH of all compositions was adjusted to approximately 7.

Table 46a

Spray composition	% w/w				Glyphosate salt
	Lecithin	LI-700	Fluorad FC-135	Surf H1	
46-01	0.10				IPA
46-02	0.05				IPA
46-03	0.02				IPA
46-04	0.10		0.10		IPA
46-05	0.05		0.05		IPA
46-06	0.02		0.02		IPA
46-07	0.10			0.10	IPA
46-08	0.05			0.05	IPA
46-09	0.02			0.02	IPA
46-10		0.10			IPA
46-11		0.05			IPA
46-12		0.02			IPA
46-13					(Bu)4N
46-14	0.05		0.05		(Bu)4N
46-15			0.05		(Bu)4N

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 19 days after planting ABUTH and 21 days after planting ECHCF, and evaluation of herbicidal inhibition was done 14 days after application.

In addition to compositions 46-01 to 46-15, spray compositions were prepared by tank mixing Formulations B and C with Fluorad FC-135 at various concentrations. Formulations B and C alone and Formulation J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 46b.

Table 46b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition ABUTH	% Inhibition ECHCF
Formulation B	150	33	24
	300	51	27
	500	68	36
	700	83	43
Formulation C	150	32	30
	300	78	68
	500	90	81
	700	96	89
Formulation J	150	16	27
	300	74	56
	500	88	79
	700	93	92
Formulation B + Fluorad FC-135 0.1% w/v	150	22	18
	300	71	26
	500	73	51
Formulation B + Fluorad FC-135 0.05% w/v	150	19	16
	300	60	28
	500	72	33
Formulation B + Fluorad FC-135 0.02% w/v	150	14	14
	300	23	26
	500	69	38
Formulation C + Fluorad FC-135 0.1% w/v	150	31	11
	300	73	27
	500	82	48
Formulation C + Fluorad FC-135 0.05% w/v	150	43	23
	300	71	49
	500	93	50
46-01	150	20	18
	300	65	29
	500	85	34
46-02	150	22	19
	300	63	35
	500	83	51
46-03	150	24	29
	300	64	35
	500	85	40
46-04	150	63	21
	300	75	31
	500	84	46
46-05	150	68	10
	300	82	29
	500	81	53
46-06	150	68	21
	300	84	30
	500	85	46

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
46-07	150	41	35
	300	51	39
	500	93	61
46-08	150	34	22
	300	77	27
	500	85	35
46-09	150	24	17
	300	78	39
	500	91	58
46-10	150	16	19
	300	62	28
	500	72	53
46-11	150	38	25
	300	59	38
	500	82	59
46-12	150	7	23
	300	61	40
	500	77	63
46-13	150	81	48
	300	92	51
	500	90	46
46-14	150	87	30
	300	91	69
	500	95	89
46-15	150	81	37
	300	94	41
	500	92	63

As in the previous Example, compositions containing "Surf H1" did not show as strong enhancement of glyphosate effectiveness as counterpart compositions containing Fluorad FC-135. The tetrabutylammonium salt of glyphosate (compositions 46-13 to 46-15) exhibited extremely high herbicidal effectiveness in this test.

EXAMPLE 47

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 47a. Process (v) was followed for all compositions using soybean lecithin (45% phospholipid, Avanti), except that various orders of addition were tried as indicated below. The pH of all compositions was approximately 5.

Table 47a

Concentrate composition	% w/w						Order of addition (*)
	Glyphosate a.e.	Lecithin	Fluorad FC-135	Fluorad FC-754	MON 0818	Agrimul PG-2069	
47-01	30	3.0	3.0		0.75		A
47-02	30	3.0	3.0		0.75		B
47-03	30	3.0	3.0		0.75		C

Concentrate composition	% w/w						Order of addition (*)
	Glyphosate a.e.	Lecithin	Fluorad FC-135	Fluorad FC-754	MON 0818	Agrimul PG-2069	
47-04	30	3.0	3.0		0.75		D
47-05	30	3.0	3.0		0.75		E
47-06	30	3.0	3.0		0.75		F
47-07	30	3.0		3.0	0.75		A
47-08	30	3.0		3.0	0.75		B
47-09	30	3.0		3.0	0.75		C
47-10	30	3.0		3.0	0.75		D
47-11	30	3.0		3.0	0.75		E
47-12	30	3.0		3.0	0.75		F
47-13	30	3.0	3.0			0.5	A
47-14	30	3.0	3.0			0.5	B
47-15	30	3.0	3.0			0.5	C
47-16	30	3.0	3.0			0.5	D
47-17	30	3.0	3.0			0.5	E
47-18	30	3.0	3.0			0.5	F

(*) Order of addition:

	1st	2nd	3rd	4th	5th
A	lecithin	MON/PG	FC-135/754	water	glyphosate
B	lecithin	FC-135	MON/PG	water	glyphosate
C	glyphosate	water	FC-135/754	MON/PG	lecithin
D	glyphosate	water	MON/PG	FC-135/754	lecithin
E	glyphosate	lecithin	MON/PG	FC-135/754	water
F	glyphosate	lecithin	FC-135/754	MON/PG	water

MON/PG means MON 0818 or Agrimul PG-2069

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 15 days after planting ABUTH and 18 days after planting ECHCF, and evaluation of herbicidal inhibition was done 15 days after application.

Formulations C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 47b.

Table 47b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation C	150	26	69
	300	75	100
	500	85	99
	700	94	100
Formulation J	150	38	78
	300	76	87
	500	87	100
	700	90	100

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
47-01	150	10	35
	300	51	56
	500	71	91
	700	77	100
47-02	150	24	35
	300	57	71
	500	77	93
	700	94	100
47-03	150	11	33
	300	48	55
	500	73	87
	700	83	93
47-04	150	37	36
	300	50	38
	500	68	94
47-05	150	24	32
	300	48	47
	500	77	85
	700	76	100
47-06	150	12	32
	300	61	40
	500	83	86
	700	88	95
47-07	150	17	25
	300	58	77
	500	73	97
	700	86	81
47-08	150	12	34
	300	53	47
	500	69	72
	700	79	100
47-09	150	10	33
	300	47	70
	500	67	99
	700	83	81
47-10	150	13	25
	300	49	51
	500	70	73
	700	85	92
47-11	150	10	22
	300	56	37
	500	77	47
	700	85	85
47-12	150	13	27
	300	61	68
	500	78	52
	700	86	85

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
47-13	150	14	27
	300	62	35
	500	72	46
	700	87	67
47-14	150	15	27
	300	59	37
	500	76	63
	700	85	61
47-15	150	10	25
	300	40	46
	500	72	88
	700	79	51
47-16	150	12	27
	300	53	41
	500	63	49
	700	71	85
47-17	150	23	25
	300	59	35
	500	70	79
	700	75	86
47-18	150	10	27
	300	56	39
	500	69	57
	700	74	93

No great or consistent differences in herbicidal effectiveness were seen with different orders of addition of ingredients.

EXAMPLE 48

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 48a. Process (v) was followed for all compositions using soybean lecithin (45% phospholipid, Avanti). Order of addition of ingredients was varied as indicated below. The pH of all compositions was approximately 5.

Table 48a

Concentrate composition	% w/w				Order of addition (*)
	Glyphosate a.e.	Lecithin	Fluorad FC-135	MON 0818	
48-01	20	6.0	6.0	2.0	A
48-02	20	6.0	6.0	2.0	B
48-03	20	6.0	6.0	2.0	C
48-04	20	6.0	3.0	2.0	A
48-05	20	6.0	3.0	2.0	B
48-06	20	6.0	3.0	2.0	C
48-07	20	6.0	1.0	2.0	A
48-08	20	6.0	1.0	2.0	B
48-09	20	6.0	1.0	2.0	C

48-10	20	6.0	0.0	2.0	A
48-11	20	6.0	0.0	2.0	B
48-12	20	6.0	0.0	2.0	C
48-13	20	2.0	2.0	0.5	A
48-14	20	2.0	2.0	0.5	B
48-15	20	2.0	2.0	0.5	C

(*) Order of addition:

	1st	2nd	3rd	4th	5th
A	lecithin	MON 0818	FC-135	water	glyphosate
B	lecithin	MON 0818	water	FC-135	glyphosate
C	lecithin	water	MON 0818	FC-135	glyphosate

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH and 16 days after planting ECHCF, and evaluation of herbicidal inhibition was done 15 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 48b.

Table 48b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	0	3
	200	17	28
	300	38	37
	500	78	68
Formulation C	100	8	63
	200	43	96
	300	88	96
	500	99	98
Formulation J	100	12	10
	200	35	60
	300	85	90
	500	98	92
48-01	100	10	0
	200	38	13
	300	73	28
	500	90	75
48-02	100	8	0
	200	40	23
	300	87	43
	500	98	62
48-03	100	12	0
	200	40	25
	300	83	47
	500	95	73

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
48-04	100	5	5
	200	45	38
	300	83	65
	500	98	83
48-05	100	10	3
	200	42	48
	300	82	53
	500	97	91
48-06	100	28	0
	200	67	43
	300	85	68
	500	97	93
48-07	100	8	8
	200	37	35
	300	75	72
	500	97	90
48-08	100	0	1
	200	37	45
	300	57	68
	500	96	97
48-09	100	0	7
	200	35	40
	300	78	60
	500	96	93
48-10	100	0	3
	200	33	57
	300	82	72
	500	96	94
48-11	100	0	5
	200	35	50
	300	78	82
	500	97	87
48-12	100	3	5
	200	40	37
	300	77	78
	500	97	85
48-13	100	3	0
	200	45	33
	300	83	38
	500	95	75
48-14	100	0	0
	200	43	33
	300	77	50
	500	96	68
48-15	100	0	0
	200	42	30
	300	78	47
	500	88	73

No great or consistent differences were seen with different orders of addition of ingredients.

EXAMPLE 49

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 49a. Process (v) was followed for all compositions using soybean lecithin (45% phospholipid, Avanti). The pH of all compositions was approximately 5.

Table 49a

Concentrate composition	% w/w				
	Glyphosate a.e.	Lecithin	Fluorad FC-135	Fluorad FC-754	MON 0818
49-01	15	4.0		8.0	0.5
49-02	15	6.0		8.0	0.5
49-03	15	8.0		8.0	0.5
49-04	10	4.0		8.0	0.5
49-05	10	6.0		8.0	0.5
49-06	10	8.0		8.0	0.5
49-07	15	4.0	8.00		0.5
49-08	15	6.0	8.00		0.5
49-09	15	8.0	8.00		0.5
49-10	15	6.0	8.25		0.5
49-11	15	6.0	8.25		4.0
49-12	15	8.0	4.00	4.0	0.5
49-13	10	8.0	8.00		0.5
49-14	10	8.0	4.00	4.0	0.5

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 22 days after planting ABUTH and 23 days after planting ECHCF, and evaluation of herbicidal inhibition was done 17 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 49b.

Table 49b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	20
	250	17	37
	350	47	47
	450	53	60
Formulation J	150	27	38
	250	68	80
	350	78	95
	450	87	95

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition ABUTH	% Inhibition ECHCF
49-01	150	15	30
	250	78	68
	350	97	87
	450	97	78
49-02	150	47	30
	250	92	80
	350	97	97
	450	98	85
49-03	150	30	35
	250	83	45
	350	97	57
	450	97	67
49-04	150	47	32
	250	80	57
	350	95	87
	450	97	96
49-05	150	32	30
	250	81	89
	350	94	95
	450	98	94
49-06	150	60	28
	250	80	96
	350	92	95
	450	98	96
49-07	150	50	23
	250	70	72
	350	92	78
	450	97	60
49-08	150	45	40
	250	72	72
	350	90	89
	450	97	77
49-09	150	53	25
	250	80	78
	350	89	89
	450	96	93
49-10	150	72	48
	250	89	83
	350	98	95
	450	98	80
49-11	150	50	27
	250	77	63
	350	93	83
	450	97	72
49-12	150	52	15
	250	83	57
	350	94	68
	450	98	63

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
49-13	150	50	30
	250	75	32
	350	88	84
	450	97	77
49-14	150	67	23
	250	84	77
	350	97	73
	450	97	72

In this test compositions prepared with Fluorad FC-754 tended to provide greater herbicidal effectiveness on ECHCF than their counterparts prepared with Fluorad FC-135.

EXAMPLE 50

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 50a. Process (v) was followed for all compositions using soybean lecithin (45% phospholipid, Avanti). The pH of all compositions was approximately 5.

Table 50a

Concentrate composition	% w/w					
	Glyphosate a.e.	Lecithin	Fluorad FC-135	Fluorad FC-754	MON 0818	Iso-propanol
50-01	15	6.0	8.25		4.0	
50-02	15	6.0		8.25	4.0	
50-03	10	8.0	8.00		0.5	
50-04	10	8.0		8.00	0.5	
50-05	20	2.0	2.00		0.5	
50-06	20	2.0		2.00	0.5	
50-07	30	3.0	3.00		0.5	
50-08	30	3.0		3.00	0.5	
50-09	30	1.0	1.00		0.5	
50-10	30	1.0		1.00	0.5	
50-11	15	6.0	8.25		4.0	5.0
50-12	15	6.0		8.25	4.0	5.0
50-13	10	8.0	8.00		2.0	5.0
50-14	10	8.0		8.00	2.0	5.0
50-15	30	3.0		3.00	0.8	
50-16	30	3.0	3.00		0.8	
50-17	10	8.0	8.00		2.0	7.5
50-18	10	8.0		8.00	2.0	7.5
50-19	10	8.0	8.00		2.0	10.0
50-20	10	8.0		8.00	2.0	10.0
50-21	10	8.0	8.00		4.0	5.0
50-22	10	8.0		8.00	4.0	5.0

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray

compositions were made 17 days after planting ABUTH and 19 days after planting ECHCF. and evaluation of herbicidal inhibition was done 15 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 50b.

Table 50b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	2	22
	250	25	28
	350	63	38
	450	70	58
Formulation C	150	30	47
	250	75	82
	350	97	97
	450	100	99
Formulation J	150	10	43
	250	58	88
	350	87	96
	450	98	93
50-01	150	63	15
	250	78	32
	350	83	70
50-02	150	60	28
	250	80	32
	350	88	65
50-03	150	53	37
	250	80	42
	350	91	27
50-04	150	72	18
	250	83	50
	350	96	80
50-05	150	50	2
	250	77	25
	350	78	43
50-06	150	22	25
	250	77	27
	350	87	40
50-07	150	27	20
	250	58	32
	350	87	37
50-08	150	32	3
	250	78	30
	350	82	52
50-09	150	5	0
	250	42	28
	350	68	43

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
50-10	150	2	23
	250	52	28
	350	75	42
50-11	150	72	27
	250	80	42
	350	85	73
50-12	150	58	23
	250	82	58
	350	87	97
50-13	150	70	8
	250	83	38
	350	85	45
50-14	150	68	37
	250	90	27
	350	89	67
50-15	150	28	28
	250	63	40
	350	87	35
50-16	150	23	13
	250	45	48
	350	82	68
50-17	150	67	2
	250	88	30
	350	87	58
50-18	150	60	38
	250	85	22
	350	95	53
50-19	150	74	38
	250	80	47
	350	95	28
50-20	150	70	25
	250	85	70
	350	97	81
50-21	150	78	5
	250	83	50
	350	90	83
50-22	150	73	33
	250	82	33
	350	95	83

Concentrate compositions having a high (20-30% a.e.) loading of glyphosate and consequently a relatively low loading of excipients showed enhancement of herbicidal effectiveness over that obtained with Formulation B, but in this test did not provide efficacy equal to commercial standard Formulations C and J.

EXAMPLE 51

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 51a. Process (i) was followed for compositions 51-13 to 51-20 and process (v) for compositions 51-01 to 51-12 using soybean lecithin (45% phospholipid, Avanti). Compositions were stored in different conditions as indicated below before testing for herbicidal effectiveness. The pH of all compositions was approximately 5.

Table 51a

Concentrate composition	% w/w						Storage conditions
	Glyphosate a.e.	Lecithin	LI-700	Fluorad FC-135	Fluorad FC-754	MON 0818	
51-01	20.0	2.0			2.0	0.5	60°C, 4d
51-02	15.0	6.0		8.25		4.0	60°C, 4d
51-03	20.0	2.0			2.0	0.5	-10°C, 4d
51-04	15.0	6.0		8.25		4.0	-10°C, 4d
51-05	20.0	2.0			2.0	0.5	room temperature, 4d
51-06	15.0	6.0		8.25		4.0	room temperature, 4d
51-07	20.0	2.0			2.0	0.5	60°C, 8h then -10°C, 4d
51-08	15.0	6.0		8.25		4.0	60°C, 8h then -10°C, 4d
51-09	20.0	2.0			2.0	0.5	freshly made
51-10	15.0	6.0		8.25		4.0	freshly made
51-11	20.0	2.0			2.0	0.5	room temperature, 42d
51-12	15.0	6.0		8.25		4.0	room temperature, 42d
51-13	15.0		18.25				
51-14	20.0		4.50				
51-15	15.0		14.25			4.0	
51-16	20.0		4.00			0.5	
51-17	15.0		10.00	8.25			
51-18	20.0		2.50		2.0		
51-19	15.0		6.00	8.25		4.0	
51-20	20.0		2.00	2.00		0.5	

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and 18 days after planting ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 51b.

Table 51b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	27	30
	250	37	38
	350	60	42
	450	69	45

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation J	150	45	61
	250	81	92
	350	93	97
	450	96	97
51-01	150	45	25
	250	49	41
	350	66	47
	450	75	63
51-02	150	49	65
	250	74	67
	350	83	88
	450	92	87
51-03	150	32	25
	250	71	70
	350	75	65
	450	77	67
51-04	150	54	68
	250	82	82
	350	91	95
	450	87	96
51-05	150	39	52
	250	63	65
	350	83	90
	450	85	93
51-06	150	67	81
	250	89	97
	350	94	100
	450	96	100
51-07	150	39	52
	250	60	88
	350	87	94
	450	85	96
51-08	150	54	82
	250	87	98
	350	93	100
	450	92	100
51-09	150	45	53
	250	67	88
	350	84	89
	450	93	93
51-10	150	56	63
	250	86	97
	350	94	99
	450	92	98
51-11	150	48	40
	250	69	55
	350	74	91

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
51-12	150	60	41
	250	86	91
	350	95	98
51-13	150	30	44
	250	37	76
	350	59	94
51-14	150	0	40
	250	49	55
	350	59	85
51-15	150	42	61
	250	71	90
	350	83	97
51-16	150	27	42
	250	49	58
	350	61	86
51-17	150	37	45
	250	52	70
	350	76	60
51-18	150	28	32
	250	53	77
	350	70	71
51-19	150	47	36
	250	69	97
	350	83	89
51-20	150	26	20
	250	56	74
	350	62	82

No great or consistent effect of storage conditions on herbicidal effectiveness of compositions was seen in this test.

EXAMPLE 52

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 52a. Process (v) was followed for all compositions using soybean lecithin (45% phospholipid, Avanti). The pH of all compositions was approximately 5.

Table 52a

Concentrate composition	% w/w						
	Glyphosate a.e.	Lecithin	Butyl stearate	Fluorad FC-754	MON 0818	Ethomeen T/25	Ethanol
52-01	20	2.0	0.5			1.25	1.0
52-02	20	2.0	0.5		1.00	1.00	1.0
52-03	20	2.0	0.5		1.25		1.0
52-04	20	6.0	1.5			3.00	3.0
52-05	20	6.0	1.5		2.00	2.00	2.0
52-06	20	6.0	1.5		3.00		3.0
52-07	20	2.0	0.5			0.50	

Concentrate composition	% w/w						
	Glyphosate a.e.	Lecithin	Butyl stearate	Fluorad FC-754	MON 0818	Ethomeen T/25	Ethanol
52-08	20	2.0	0.5			2.50	
52-09	20	2.0	0.5		1.25	1.25	
52-10	20	6.0	1.5			0.50	
52-11	20	6.0	1.5			3.00	
52-12	20	6.0	1.5			6.00	
52-13	20	6.0	1.5		3.00	3.00	
52-14	20	2.0		2.0	0.50		
52-15	20	6.0		3.0	6.00		
52-16	20	6.0		6.0	6.00		

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 15 days after application.

Formulation J was applied as a comparative treatment. Results, averaged for all replicates of each treatment, are shown in Table 52b.

Table 52b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation J	150	38	45
	250	80	63
	350	78	82
	450	75	55
52-01	150	23	27
	250	57	53
	350	70	85
	450	70	83
52-02	150	7	25
	250	52	45
	350	82	88
	450	82	90
52-03	150	38	35
	250	50	40
	350	82	92
	450	83	93
52-04	150	40	48
	250	73	75
	350	78	92
	450	88	92
52-05	150	50	53
	250	68	80
	350	85	98
	450	89	96

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
52-06	150	50	43
	250	55	80
	350	78	97
	450	85	91
52-07	150	3	28
	250	22	43
	350	67	72
	450	73	75
52-08	150	43	33
	250	77	63
	350	89	78
	450	97	85
52-09	150	57	27
	250	95	63
	350	89	86
	450	98	88
52-10	150	32	23
	250	33	55
	350	73	82
	450	67	60
52-11	150	45	32
	250	78	72
	350	95	92
	450	98	96
52-12	150	67	42
	250	80	75
	350	96	88
	450	97	90
52-13	150	73	42
	250	83	77
	350	96	91
	450	98	88
52-14	150	57	30
	250	77	72
	350	84	80
	450	96	75
52-15	150	72	38
	250	88	82
	350	98	92
	450	98	87
52-16	150	85	49
	250	97	47
	350	97	83
	450	98	85

Very high herbicidal effectiveness was obtained in this test with concentrate compositions containing lecithin and Fluorad FC-754. Composition 52-14, containing each of these excipients at the

very low weight/weight ratio to glyphosate a.e. of 1:10, was at least as effective as commercial standard Formulation J, while compositions 52-15 and 52-16 were still more effective. Also performing very well in this test, particularly on ECHCF, were a number of concentrate compositions containing lecithin and butyl stearate.

EXAMPLE 53

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 53a. Process (v) was followed for all compositions using soybean lecithin (45% phospholipid, Avanti). Order of addition of ingredients was varied for certain compositions as indicated below. The pH of all compositions was approximately 5.

Table 53a

Concentrate composition	Glyphosate g/l a.e.	% w/w					Order of addition (*)
		Lecithin	Fluorad FC-754/135	Benzalk-onium Cl	Butyl stearate	MON 0818	
53-01	345	4.0		0.66			
53-02	345	4.0		1.00			
53-03	347	3.0		3.00			
53-04	347	4.0		4.00			
53-05	347	4.0		5.00			
53-06	345	4.6		4.60			
53-07	348	4.0	2.0 (754)	1.10			
53-08	351	4.0	4.0 (754)	1.00			A
53-09	346	3.9	4.2 (754)	1.00			B
53-10	350	4.0	2.0 (135)	1.10			
53-11	352	4.0	4.0 (135)	1.00			A
53-12	349	4.0	4.0 (135)	1.00			B
53-13	348	4.0	4.0 (754)	0.50	0.57		
53-14	347	4.0		0.50	0.52		
53-15	348	3.7		0.48		3.7	
53-16	348	4.0		0.58		4.0	

(*) Order of addition:

	1st	2nd	3rd	4th	5th
A	lecithin	water	Benzalkonium Cl	FC-135/754	glyphosate
B	glyphosate	FC-135/754	Benzalkonium Cl	water	glyphosate

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 21 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 53b.

Table 53b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	5	5
	200	15	20
	300	47	30
	400	65	37
Formulation J	100	0	8
	200	70	37
	300	78	70
	400	83	73
53-01	100	3	10
	200	17	27
	300	45	37
	400	75	40
53-02	100	2	5
	200	13	30
	300	43	40
	400	75	47
53-03	100	0	8
	200	17	43
	300	65	78
	400	78	83
53-04	100	2	10
	200	30	37
	300	68	72
	400	75	88
53-05	100	2	20
	200	25	65
	300	63	88
	400	82	83
53-06	100	10	17
	200	25	33
	300	47	77
	400	83	75
53-07	100	0	10
	200	48	30
	300	73	37
	400	83	43
53-08	100	3	10
	200	33	30
	300	68	37
	400	78	40
53-09	100	5	10
	200	40	27
	300	65	50
	400	70	57

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
53-10	100	0	10
	200	30	27
	300	67	40
	400	73	40
53-11	100	0	10
	200	33	27
	300	52	37
	400	82	40
53-12	100	0	10
	200	40	20
	300	65	40
	400	72	40
53-13	100	0	10
	200	40	20
	300	60	33
	400	78	33
53-14	100	0	10
	200	7	47
	300	28	33
	400	43	43
53-15	100	0	13
	200	27	33
	300	73	53
	400	77	67
53-16	100	0	13
	200	30	37
	300	75	47
	400	77	68

Most concentrate compositions of this Example showed enhanced glyphosate effectiveness by comparison with Formulation B but did not equal the efficacy of commercial standard Formulation J in this test.

EXAMPLE 54

Aqueous spray and concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 54a. Process (i) was followed for spray compositions 54-37 to 54-60 and process (iii) for spray compositions 54-01 to 54-36 using soybean lecithin (45% phospholipid, Avanti). Process (v) was followed for concentrate compositions 54-61 to 54-63 using soybean lecithin (45% phospholipid, Avanti). The pH of all compositions was approximately 5.

Table 54a

Composition	Glyphosate g a.e./l	% w/w		Type of fluoro-organic
		Lecithin	Fluoro-organic	
Spray composition				
54-01	1.60	0.027	0.027	Fluorad FC-754
54-02	2.66	0.045	0.045	Fluorad FC-754

Composition	Glyphosate g a.e./l	% w/w		Type of fluoro-organic
		Lecithin	Fluoro-organic	
54-03	3.72	0.062	0.062	Fluorad FC-754
54-04	4.79	0.080	0.080	Fluorad FC-754
54-05	1.60	0.027	0.027	Fluorad FC-750
54-06	2.66	0.045	0.045	Fluorad FC-750
54-07	3.72	0.062	0.062	Fluorad FC-750
54-08	4.79	0.080	0.080	Fluorad FC-750
54-09	1.60	0.027	0.027	Fluorad FC-751
54-10	2.66	0.045	0.045	Fluorad FC-751
54-11	3.72	0.062	0.062	Fluorad FC-751
54-12	4.79	0.080	0.080	Fluorad FC-751
54-13	1.60	0.027	0.027	Fluorad FC-760
54-14	2.66	0.045	0.045	Fluorad FC-760
54-15	3.72	0.062	0.062	Fluorad FC-760
54-16	4.79	0.080	0.080	Fluorad FC-760
54-17	1.60	0.027	0.027	Fluorad FC-120
54-18	2.66	0.045	0.045	Fluorad FC-120
54-19	3.72	0.062	0.062	Fluorad FC-120
54-20	4.79	0.080	0.080	Fluorad FC-120
54-21	1.60	0.027	0.027	Fluorad FC-171
54-22	2.66	0.045	0.045	Fluorad FC-171
54-23	3.72	0.062	0.062	Fluorad FC-171
54-24	4.79	0.080	0.080	Fluorad FC-171
54-25	1.60	0.027	0.027	Fluorad FC-129
54-26	2.66	0.045	0.045	Fluorad FC-129
54-27	3.72	0.062	0.062	Fluorad FC-129
54-28	4.79	0.080	0.080	Fluorad FC-129
54-29	1.60	0.027	0.027	Fluorad FC-170C
54-30	2.66	0.045	0.045	Fluorad FC-170C
54-31	3.72	0.062	0.062	Fluorad FC-170C
54-32	4.79	0.080	0.080	Fluorad FC-170C
54-33	1.60		0.027	Fluorad FC-754
54-34	2.66		0.045	Fluorad FC-754
54-35	3.72		0.062	Fluorad FC-754
54-36	4.79		0.080	Fluorad FC-754
54-37	1.60		0.027	Fluorad FC-750
54-38	2.66		0.045	Fluorad FC-750
54-39	3.72		0.062	Fluorad FC-750
54-40	4.79		0.080	Fluorad FC-750
54-41	1.60		0.027	Fluorad FC-760
54-42	2.66		0.045	Fluorad FC-760
54-43	3.72		0.062	Fluorad FC-760
54-44	4.79		0.080	Fluorad FC-760
54-45	1.60		0.027	Fluorad FC-120
54-46	2.66		0.045	Fluorad FC-120
54-47	3.72		0.062	Fluorad FC-120
54-48	4.79		0.080	Fluorad FC-120
54-49	1.60		0.027	Fluorad FC-171
54-50	2.66		0.045	Fluorad FC-171
54-51	3.72		0.062	Fluorad FC-171

Composition	Glyphosate g a.c./l	% w/w		Type of fluoro-organic
		Lecithin	Fluoro-organic	
54-52	4.79		0.080	Fluorad FC-171
54-53	1.60		0.027	Fluorad FC-129
54-54	2.66		0.045	Fluorad FC-129
54-55	3.72		0.062	Fluorad FC-129
54-56	4.79		0.080	Fluorad FC-129
54-57	1.60		0.027	Fluorad FC-170C
54-58	2.66		0.045	Fluorad FC-170C
54-59	3.72		0.062	Fluorad FC-170C
54-60	4.79		0.080	Fluorad FC-170C
Concentrate compositions:				
54-61	180	1.5	1.5	Fluorad FC-754
54-62	180	2.5	2.5	Fluorad FC-754
54-63	180	3.0	6.0	Fluorad FC-754

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 19 days after planting ABUTH and 19 days after planting ECHCF, and evaluation of herbicidal inhibition was done 16 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 54b.

Table 54b

Spray or concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	47	88
	250	68	96
	350	86	98
	450	93	100
Formulation J	150	68	89
	250	94	97
	350	98	100
	450	100	99
54-01	150	94	83
54-02	250	97	99
54-03	350	97	99
54-04	450	99	100
54-05	150	93	77
54-06	250	94	96
54-07	350	97	94
54-08	450	98	99
54-09	150	53	72
54-10	250	68	86
54-11	350	73	99
54-12	450	91	96
54-13	150	58	70
54-14	250	72	94

Spray or concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
54-15	350	89	95
54-16	450	93	92
54-17	150	50	62
54-18	250	58	78
54-19	350	85	93
54-20	450	84	96
54-21	150	53	63
54-22	250	83	85
54-23	350	89	90
54-24	450	96	86
54-25	150	53	57
54-26	250	78	85
54-27	350	90	91
54-28	450	96	93
54-29	150	62	70
54-30	250	84	92
54-31	350	97	97
54-32	450	97	98
54-33	150	94	79
54-34	250	96	97
54-35	350	97	99
54-36	450	98	99
54-37	150	90	84
54-38	250	99	96
54-39	350	98	100
54-40	450	99	100
54-41	150	68	75
54-42	250	73	88
54-43	350	83	92
54-44	450	92	98
54-45	150	48	53
54-46	250	60	88
54-47	350	82	97
54-48	450	95	95
54-49	150	50	47
54-50	250	63	89
54-51	350	83	91
54-52	450	91	90
54-53	150	48	52
54-54	250	63	75
54-55	350	91	92
54-56	450	97	97
54-57	150	50	83
54-58	250	73	94
54-59	350	91	98
54-60	450	94	98

Spray or concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
54-61	150	63	52
	250	96	96
	350	97	96
54-62	150	77	77
	250	93	87
	350	98	98
54-63	150	83	89
	250	96	96
	350	98	98

Outstanding herbicidal efficacy, even by comparison with Formulation J, was obtained in this test from spray compositions containing lecithin and Fluorad FC-754 (54-01 to 54-04). Substitution of other fluoro-organic surfactants for Fluorad FC-754 gave varying results. Fluorad FC-750 (compositions 54-05 to 54-08) was an acceptable substitute; however Fluorad FC-751, Fluorad FC-760, Fluorad FC-120, Fluorad FC-171, Fluorad FC-129 and Fluorad FC-170C (compositions 54-09 to 54-32) provided less enhancement. A similar pattern was seen with spray compositions (54-33 to 54-60) containing the same fluoro-organic surfactants as above with the exception of Fluorad FC-751, but no lecithin. It is noteworthy that of all the fluoro-organic surfactants included in this test, only Fluorad FC-754 and Fluorad FC-750 are cationic. Excellent herbicidal efficacy was also noted in this test from concentrate glyphosate compositions containing lecithin and Fluorad FC-754, especially composition 54-63.

EXAMPLE 55

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 55a. Concentrate compositions 55-01 to 55-07, 55-17 and 55-18 were prepared by process (v). Concentrate compositions 55-08 to 55-15 were prepared by process (x). The other concentrate compositions of this Example were included for comparison purposes.

Table 55a

Conc. comp.	Glyphosate g a.e./l	% w/w						
		Lecithin	Fluorad FC-754	Butyl stearate	Ethomeen T/25	Ceteareth-20	Arcosolve DPM	Ceteareth-27
55-01	348	3.0	3.00		0.75			
55-02	348	3.8	3.75		5.00			
55-03	348	3.8	3.75		7.50			
55-04	348	2.0	5.00		0.75			
55-05	348	5.0	5.00		0.75			
55-06	348	2.0	2.00					
55-07	348	1.0	1.00					
55-08	220	1.5		1.5	3.00	3.0		
55-09	220	1.5		1.5	3.00			3.0
55-10	220	1.5		1.5	6.00	3.0		
55-11	220	1.5		1.5	6.00			3.0
55-12	220	3.0		1.5	3.00	3.0		

Conc. comp.	Glyphosate g a.e./l	% w/w						
		Lecithin	Fluorad FC-754	Butyl stearate	Ethomeen T/25	Ceteareth-20	Arcosolve DPM	Ceteareth-27
55-13	220	3.0		1.5	3.00			3.0
55-14	348	1.5		1.5	6.00	3.0		
55-15	348	3.0		1.5	3.00	3.0		
55-16	348		3.00					
55-17	348	3.0					3.0	
55-18	348	5.0			13.00		5.0	

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 55b.

Table 55b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	28	32
	200	41	37
	300	73	64
	400	22	30
Formulation J	100	38	32
	200	82	73
	300	89	91
	400	97	89
55-01	100	73	28
	200	90	66
	300	97	92
	400	100	96
55-02	100	77	32
	200	87	67
	300	84	78
	400	98	84
55-03	100	79	33
	200	82	66
	300	99	81
	400	97	88
55-04	100	69	35
	200	95	59
	300	96	84
	400	92	91
55-05	100	82	32
	200	92	55
	300	96	71
	400	94	87

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
55-06	100	83	33
	200	100	52
	300	100	68
	400	99	75
55-07	100	77	35
	200	90	58
	300	95	71
	400	94	90
55-08	100	51	40
	200	89	75
	300	96	92
	400	95	98
55-09	100	76	57
	200	98	81
	300	97	86
	400	96	98
55-10	100	69	60
	200	98	63
	300	95	82
	400	99	90
55-11	100	61	60
	200	94	84
	300	97	89
	400	99	97
55-12	100	64	53
	200	95	82
	300	96	90
	400	95	98
55-13	100	61	58
	200	94	78
	300	88	87
	400	100	94
55-14	100	56	61
	200	88	77
	300	91	82
	400	97	89
55-15	100	42	52
	200	82	80
	300	86	90
	400	97	92
55-16	100	64	49
	200	86	75
	300	97	88
	400	100	82
55-17	100	57	32
	200	88	66
	300	95	73
	400	100	88

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
55-18	100	52	35
	200	70	77
	300	82	79
	400	97	73

Concentrate compositions 55-01 to 55-07, containing lecithin and Fluorad FC-754, exhibited outstanding herbicidal effectiveness. On ABUTH, several of these were about as effective at 100 g a.e./ha as commercial standard Formulation J at 200 g a.e./ha. On ECHCF, all exhibited strong enhancement over Formulation B but most did not equal Formulation J on this species. The performance of composition 55-07, containing lecithin and Fluorad FC-754 each at the extremely low weight/weight ratio to glyphosate a.e. of about 1:30, was remarkably high. The inclusion of a relatively high concentration of Ethomeen T/25, as in compositions 55-02 and 55-03, was not helpful to herbicidal effectiveness in the presence of lecithin and Fluorad FC-754, and may even have been detrimental. The relatively poor performance of composition 55-18, having a high Ethomeen T/25 concentration but in this case no Fluorad FC-754, is consistent with this observation. Without being bound by theory, it is believed that the presence of such high concentrations of Ethomeen T/25 together with lecithin results in the formation of mixed micelles rather than liposomes in aqueous dispersion. Composition 55-16, containing Fluorad FC-754 at a weight/weight ratio to glyphosate a.e. of about 1:10, but no lecithin, exhibited herbicidal effectiveness similar to that of composition 55-01, suggesting that under the conditions of this test a large part of the enhancement due to the lecithin/Fluorad FC-754 combination was attributable to the Fluorad FC-754 component.

Compositions 55-08 to 55-15, containing lecithin, butyl stearate, Ethomeen T/25 and a C_{16-18} alkylether surfactant (ceteareth-20 or ceteareth-27) exhibited a very high degree of herbicidal effectiveness. Not only was performance, at least of 55-08 to 55-13, on ABUTH substantially better than that of Formulation J, these compositions performed considerably better than Formulation J on ECHCF as well.

EXAMPLE 56

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 56a. Process (i) was followed for compositions 56-61 to 56-64, 56-67, 56-69 and 56-71 and process (iii) for compositions 56-01 to 56-60, 56-66, 56-68, 56-70 and 56-72 using soybean lecithin (45% phospholipid, Avanti). The pH of all compositions was approximately 5.

Table 56a

Spray composition	% w/w				
	Lecithin	MON 0818	Fluorad FC-754	Ethomeen T/25	Ethomeen C/12
56-01	0.020	0.025	0.02		
56-02	0.030	0.025	0.02		

Spray composition	% w/w				
	Lecithin	MON 0818	Fluorad FC-754	Ethomeen T/25	Ethomeen C/12
56-03	0.050	0.025	0.02		
56-04	0.020	0.025	0.03		
56-05	0.030	0.025	0.03		
56-06	0.050	0.025	0.03		
56-07	0.020	0.025	0.04		
56-08	0.030	0.025	0.04		
56-09	0.050	0.025	0.04		
56-10	0.020	0.025	0.05		
56-11	0.030	0.025	0.05		
56-12	0.050	0.025	0.05		
56-13	0.020		0.02		
56-14	0.030		0.02		
56-15	0.050		0.02		
56-16	0.020		0.03		
56-17	0.030		0.03		
56-18	0.050		0.03		
56-19	0.020		0.04		
56-20	0.030		0.04		
56-21	0.050		0.04		
56-22	0.020		0.05		
56-23	0.030		0.05		
56-24	0.050		0.05		
56-25	0.020		0.02	0.025	
56-26	0.030		0.02	0.025	
56-27	0.050		0.02	0.025	
56-28	0.020		0.03	0.025	
56-29	0.030		0.03	0.025	
56-30	0.050		0.03	0.025	
56-31	0.020		0.04	0.025	
56-32	0.030		0.04	0.025	
56-33	0.050		0.04	0.025	
56-34	0.020		0.05	0.025	
56-35	0.030		0.05	0.025	
56-36	0.050		0.05	0.025	
56-37	0.020		0.02		0.025
56-38	0.030		0.02		0.025
56-39	0.050		0.02		0.025
56-40	0.020		0.03		0.025
56-41	0.030		0.03		0.025
56-42	0.050		0.03		0.025
56-43	0.020		0.04		0.025
56-44	0.030		0.04		0.025
56-45	0.050		0.04		0.025
56-46	0.020		0.05		0.025
56-47	0.030		0.05		0.025
56-48	0.050		0.05		0.025
56-49	0.020		0.02	0.050	
56-50	0.025		0.03	0.050	

Spray composition	% w/w				
	Lecithin	MON 0818	Fluorad FC-754	Ethomeen T/25	Ethomeen C/12
56-51	0.050		0.02	0.050	
56-52	0.020		0.03	0.050	
56-53	0.030		0.03	0.050	
56-54	0.050		0.03	0.050	
56-55	0.020	0.050	0.02		
56-56	0.025	0.050	0.03		
56-57	0.050	0.050	0.02		
56-58	0.020	0.050	0.03		
56-59	0.030	0.050	0.03		
56-60	0.050	0.050	0.03		
56-61		0.050			
56-62				0.050	
56-63					0.025
56-64		0.025			
56-65	0.050		0.08	0.025	
56-66	0.025		0.03		0.025
56-67			0.05		
56-68	0.050				
56-69			0.05	0.050	
56-70	0.050			0.050	
56-71		0.050	0.05		
56-72	0.050	0.050			

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 15 days after application.

Formulation J was applied as a comparative treatment. Results, averaged for all replicates of each treatment, are shown in Table 56b.

Table 56b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation J	100	14	42
	187	44	87
	300	71	90
	400	92	97
56-01	187	80	80
56-02	187	80	97
56-03	187	79	94
56-04	187	79	91
56-05	187	81	80
56-06	187	73	88
56-07	187	86	90
56-08	187	88	91

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
56-09	187	77	85
56-10	187	81	80
56-11	187	88	68
56-12	187	87	72
56-13	187	85	61
56-14	187	83	47
56-15	187	86	61
56-16	187	86	57
56-17	187	85	44
56-18	187	81	62
56-19	187	82	63
56-20	187	87	62
56-21	187	84	48
56-22	187	80	67
56-23	187	86	89
56-24	187	78	64
56-25	187	84	87
56-26	187	81	81
56-27	187	74	85
56-28	187	71	90
56-29	187	76	74
56-30	187	81	89
56-31	187	78	80
56-32	187	79	84
56-33	187	82	84
56-34	187	74	87
56-35	187	81	89
56-36	187	85	79
56-37	187	68	89
56-38	187	69	85
56-39	187	86	85
56-40	187	83	89
56-41	187	77	76
56-42	187	83	76
56-43	187	74	83
56-44	187	84	69
56-45	187	85	71
56-46	187	80	86
56-47	187	83	96
56-48	187	81	87
56-49	187	75	99
56-50	187	78	97
56-51	187	76	97
56-52	187	77	92
56-53	187	74	88
56-54	187	73	81
56-55	187	70	87
56-56	187	79	88
56-57	187	72	89

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
56-58	187	72	79
56-59	187	53	80
56-60	187	80	73
56-61	187	46	78
56-62	187	54	94
56-63	187	48	98
56-64	187	59	97
56-65	187	87	84
56-66	187	89	96
56-67	187	86	69
56-68	187	46	43
56-69	187	75	90
56-70	187	55	83
56-71	187	79	80
56-72	187	55	82

All compositions of this Example containing Fluorad FC-754 showed much greater herbicidal effectiveness on ABUTH at 187 g a.e./ha than did Formulation J at the same rate, in many cases giving inhibition of ABUTH equal to or greater than provided by Formulation J at 300 g a.e./ha. The only compositions of the Example not showing strong improvement over Formulation J on ABUTH were 56-61 to 56-64, 56-68, 56-70 and 56-72. These are the only formulations of the Example not containing Fluorad FC-754.

EXAMPLE 57

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 57a. Process (i) was followed for compositions 57-02, 57-04, 57-06, 57-08, 57-10, 57-12, 57-14 and 57-16 to 57-18, and process (iii) for compositions 57-01, 57-03, 57-05, 57-07, 57-09, 57-11 and 57-13 using soybean lecithin (45% phospholipid, Avanti). The pH of all compositions was approximately 5.

Table 57a

Spray composition	%w/w		Type of surfactant
	Lecithin	Surfactant	
57-01	0.05	0.05	Surf H2
57-02		0.05	Surf H2
57-03	0.05	0.05	Surf H3
57-04		0.05	Surf H3
57-05	0.05	0.05	Surf H4
57-06		0.05	Surf H4
57-07	0.05	0.05	Surf H5
57-08		0.05	Surf H5
57-09	0.05	0.05	Fluorad FC-754
57-10		0.05	Fluorad FC-754
57-11	0.05	0.05	Surf H1
57-12		0.05	Surf H1

Spray composition	%w/w		Type of surfactant
	Lecithin	Surfactant	
57-13	0.05	0.05	MON 0818
57-14		0.05	MON 0818
57-15	0.05	0.05	Ethomeen T/25
57-16		0.05	Ethomeen T/25
57-17		0.10	MON 0818
57-18		0.10	Ethomeen T/25

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 16 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 57b.

Table 57b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	12	22
	200	43	43
	300	63	78
	400	75	82
Formulation J	100	47	27
	200	89	83
	300	98	98
	400	99	97
57-01	100	65	60
	200	94	84
	300	99	97
	400	100	98
57-02	100	40	45
	200	77	75
	300	91	90
	400	94	98
57-03	100	63	37
	200	82	82
	300	97	99
	400	99	97
57-04	100	52	38
	200	79	73
	300	95	98
	400	99	97
57-05	100	73	68
	200	85	94
	300	98	99
	400	100	99

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
57-06	100	38	58
	200	73	92
	300	85	100
	400	100	98
57-07	100	50	43
	200	80	78
	300	94	86
	400	94	95
57-08	100	50	48
	200	75	62
	300	89	77
	400	90	79
57-09	100	91	47
	200	98	75
	300	99	97
	400	99	94
57-10	100	87	38
	200	89	73
	300	99	83
	400	100	94
57-11	100	77	73
	200	93	79
	300	98	96
	400	99	98
57-12	100	55	52
	200	82	89
	300	96	99
	400	99	100
57-13	100	75	63
	200	93	92
	300	98	99
	400	99	99
57-14	100	78	82
	200	88	86
	300	96	99
	400	99	100
57-15	100	77	68
	200	94	95
	300	98	97
	400	99	98
57-16	100	75	75
	200	88	99
	300	98	99
	400	99	100
57-17	100	72	77
	200	85	98
	300	98	100
	400	99	99

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
57-18	100	77	77
	200	90	96
	300	97	99
	400	99	100

Herbicidal activity with compositions 57-13 to 57-18, based on alkylamine based surfactants known in the art, was very high in this test. Compositions 57-01 to 57-12 of the present invention also exhibited excellent herbicidal effectiveness. Overall, surfactants "Surf H1" to "Surf H5" having hydrocarbon hydrophobes were not quite as effective as Fluorad FC-754 having a fluorocarbon hydrophobe, either when used as sole excipient substance or together with lecithin.

EXAMPLE 58

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 58a. These compositions are water-in-oil-in-water multiple emulsions and were prepared by process (vi) described above.

Table 58a

Conc. comp.	% w/w				% in inner aq. phase		Emulsifier #1	Emulsifier #2
	Glyphosate a.e.	Butyl stearate	Emulsifier #1	Emulsifier #2	Water	Glyphosate		
58-01	10	18.0	3.0	5.0	9.0	20	Span 80	Tween 20
58-02	10	7.5	3.0	5.0	4.5	20	Span 80	Tween 20
58-03	10	7.5	3.0	10.0	4.5	0	Surfynol 104	Neodol 25-12
58-04	10	7.5	3.0	10.0	4.5	0	Surfynol 104	Neodol 25-20
58-05	10	7.5	3.0	10.0	4.5	0	Surfynol 104	Tergitol 15-S-15
58-06	10	7.5	3.0	10.0	4.5	0	Surfynol 104	Tergitol 15-S-20
58-07	10	7.5	3.0	10.0	4.5	0	Surfynol 104	Tween 20
58-08	10	7.5	3.0	10.0	4.5	0	Surfynol 104	ceteareth-55
58-09	10	7.5	3.0	10.0	4.5	0	Surfynol 104	Tergitol 15-S-30
58-10	10	7.5	3.0	10.0	4.5	0	Neodol 25-3	ceteareth-55
58-11	10	7.5	3.0	10.0	4.5	0	Neodol 25-3	Tergitol 15-S-30
58-12	10	7.5	3.0	10.0	4.5	0	Span 60	ceteareth-55
58-13	10	7.5	3.0	10.0	4.5	0	Span 60	Tergitol 15-S-30
58-14	10	7.5	3.0	10.0	4.5	0	oleth-2	ceteareth-55
58-15	10	7.5	3.0	10.0	4.5	0	oleth-2	Tergitol 15-S-30
58-16	10	7.5	3.0	10.0	4.5	0	Emid 6545	ceteareth-55
58-17	10	7.5	3.0	10.0	4.5	0	Emid 6545	Tergitol 15-S-30

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 35 days after planting ABUTH and 33 days after planting ECHCF, and evaluation of herbicidal inhibition was done 17 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 58b.

Table 58b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	0
	250	35	40
	350	50	63
	450	60	43
Formulation C	150	63	63
	250	80	96
	350	92	98
	450	98	87
Formulation J	150	43	30
	250	75	85
	350	82	98
	450	96	95
58-01	150	65	53
	250	85	70
	350	90	87
	450	98	73
58-02	150	63	5
	250	78	53
	350	88	80
	450	97	87
58-03	150	75	0
	250	87	22
	350	88	72
	450	97	17
58-04	150	84	0
	250	90	10
	350	95	70
	450	98	60
58-05	150	77	0
	250	83	3
	350	93	30
	450	95	10
58-06	150	72	0
	250	83	47
	350	94	60
	450	98	20
58-07	150	75	0
	250	77	40
	350	96	47
	450	96	50
58-08	150	87	40
	250	97	82
	350	99	83
	450	100	77

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
58-09	150	82	10
	250	82	40
	350	96	67
	450	97	67
58-10	150	82	13
	250	94	83
	350	99	85
	450	99	83
58-11	150	73	17
	250	83	60
	350	88	73
	450	96	63
58-12	150	80	20
	250	93	85
	350	96	82
	450	96	82
58-13	150	78	20
	250	83	50
	350	92	90
	450	92	85
58-14	150	80	30
	250	97	85
	350	99	99
	450	97	96
58-15	150	82	30
	250	87	75
	350	99	92
	450	99	93
58-16	150	82	53
	250	96	82
	350	96	97
	450	87	82
58-17	150	72	20
	250	80	63
	350	92	75
	450	95	87

Considerable variation was seen in herbicidal effectiveness of water-in-oil-in-water multiple emulsions of this Example, especially on ECHCF. Among the most efficacious were 58-08, 58-10, 58-12, 58-14 and 58-16. All of these contained a C_{16-18} alkylether surfactant, ceteareth-55. When Tergitol 15-S-30, a C_{12-15} secondary alkylether surfactant, replaced ceteareth-55, as in 58-09, 58-11, 58-13, 58-15 and 58-17, herbicidal effectiveness, at least on ECHCF, was in most cases markedly reduced.

EXAMPLE 59

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient

ingredients as shown in Table 59a. Concentrate compositions 59-01 and 59-02 are water-in-oil-in-water multiple emulsions and were prepared by process (vi), using Span 80 as emulsifier #1. Concentrate compositions 59-03 to 59-12 and 59-14 to 59-17 are oil-in-water emulsions and were prepared by process (vii). Concentrate composition 59-13 is an aqueous solution concentrate and was prepared by process (viii), the component indicated below as "emulsifier #2" being the surfactant component.

Table 59a

Conc. comp.	% w/w				% in inner aq. Phase		Emulsifier #2
	Glyphos-ate a.e.	Butyl stearate	Span 80	Emulsifier #2	Water	Glyphosate	
59-01	10	18.0	3.0	5.0	12.2	20	Tween 20
59-02	10	7.5	3.0	5.0	5.3	20	Tween 20
59-03	10	1.0		10.0			Neodol 25-20
59-04	10	3.0		10.0			Neodol 25-20
59-05	10	1.0		5.0			Neodol 25-20
59-06	10	3.0		5.0			Neodol 25-20
59-07	15	1.0		10.0			Neodol 25-20
59-08	15	3.0		10.0			Neodol 25-20
59-09	15	1.0		5.0			Neodol 25-20
59-10	15	3.0		5.0			Neodol 25-20
59-11	20	1.0		5.0			Neodol 25-20
59-12	20	1.0		10.0			Neodol 25-20
59-13	10			10.0			Neodol 25-20
59-14	10	7.5		10.0			Neodol 25-20
59-15	10	7.5		10.0			Neodol 25-12
59-16	10	7.5		10.0			steareth-20
59-17	10	7.5		10.0			oleth-20

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and 19 days after planting ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 59b.

Table 59b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	30
	250	10	40
	350	37	73
	450	58	68
Formulation C	150	42	79
	250	77	98
	350	99	97
	450	97	93

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition ABUTH	% Inhibition ECHCF
Formulation J	150	43	67
	250	73	90
	350	94	98
	450	77	78
59-01	150	58	76
	250	75	77
	350	88	93
	450	95	83
59-02	150	27	63
	250	60	87
	350	82	98
	450	77	92
59-03	150	47	76
	250	65	92
	350	94	99
	450	95	91
59-04	150	70	86
	250	86	95
	350	97	98
	450	99	90
59-05	150	42	80
	250	72	90
	350	90	93
	450	99	96
59-06	150	48	57
	250	78	92
	350	94	99
	450	96	92
59-07	150	78	95
	250	96	96
	350	98	98
	450	100	97
59-08	150	88	96
	250	98	98
	350	100	99
	450	100	99
59-09	150	82	93
	250	94	96
	350	99	97
	450	99	93
59-10	150	72	83
	250	97	93
	350	99	100
	450	100	98
59-11	150	87	83
	250	98	97
	350	100	99
	450	100	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
59-12	150	93	99
	250	99	99
	350	99	97
	450	100	99
59-13	150	70	90
	250	91	88
	350	97	94
	450	99	86
59-14	150	67	76
	250	93	80
	350	98	95
	450	95	78
59-15	150	68	65
	250	90	87
	350	97	80
	450	98	93
59-16	150	83	73
	250	90	93
	350	99	100
	450	100	100
59-17	150	80	66
	250	98	77
	350	99	83
	450	100	85

Very high herbicidal activity was evident in compositions 59-13 to 59-17, which have a very high ratio of surfactant to glyphosate a.e. of 1:1. Activity was too high to clearly distinguish among these compositions, but 59-16 and 59-17, containing steareth-20 and oleth-20 respectively, exhibited greater effectiveness on ABUTH at the lowest glyphosate rate than 59-14 and 59-15, containing Neodol 25-20 and Neodol 25-12 respectively.

EXAMPLE 60

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 60a. Concentrate compositions 60-01 and 60-02 are water-in-oil-in-water multiple emulsions and were prepared by process (vi), using Span 80 as emulsifier #1. Concentrate compositions 60-03 to 60-12 and 60-14 to 60-17 are oil-in-water emulsions and were prepared by process (vii). Concentrate composition 60-13 is an aqueous solution concentrate and was prepared by process (viii), the component indicated below as “emulsifier #2” being the surfactant component.

Table 60a

Conc. comp.	% w/w				% in inner aq. phase		Emulsifier #2
	Glyphos-ate a.e.	Butyl stearate	Span 80	Emulsifier #2	Water	Glyphosate	
60-01	10	18.0	3.0	5.0	12.2	20	Tween 20
60-02	10	7.5	3.0	5.0	5.3	20	Tween 20
60-03	10	1.0		10.0			Tween 80
60-04	10	3.0		10.0			Tween 80
60-05	10	1.0		5.0			Tween 80
60-06	10	3.0		5.0			Tween 80
60-07	15	1.0		10.0			Tween 80
60-08	15	3.0		10.0			Tween 80
60-09	15	1.0		5.0			Tween 80
60-10	15	3.0		5.0			Tween 80
60-11	20	1.0		5.0			Tween 80
60-12	20	1.0		10.0			Tween 80
60-13	10			10.0			Tween 80
60-14	10	7.5		10.0			Tween 80
60-15	10	7.5		10.0			Neodol 25-20
60-16	10	7.5		10.0			steareth-20
60-17	10	7.5		10.0			oleth-20

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and 19 days after planting ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 60b.

Table 60b

Composition applied	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	0
	250	3	10
	350	17	20
	450	20	30
Formulation C	150	70	33
	250	80	70
	350	85	80
	450	97	77
Formulation J	150	7	20
	250	70	80
	350	78	80
	450	83	80
60-01	150	40	7
	250	48	20
	350	73	23
	450	75	30

Composition applied	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
60-02	150	3	0
	250	10	17
	350	47	23
	450	50	30
60-03	150	0	2
	250	33	13
	350	63	40
	450	68	43
60-04	150	17	7
	250	43	20
	350	78	63
	450	78	63
60-05	150	10	3
	250	20	13
	350	58	40
	450	75	40
60-06	150	3	0
	250	27	20
	350	60	23
	450	72	23
60-07	150	32	10
	250	68	20
	350	75	50
	450	86	60
60-08	150	27	20
	250	68	30
	350	82	40
	450	90	73
60-09	150	43	10
	250	60	33
	350	72	63
	450	75	73
60-10	150	33	10
	250	62	30
	350	77	60
	450	83	70
60-11	150	48	13
	250	72	63
	350	83	80
	450	87	80
60-12	150	23	13
	250	60	50
	350	75	80
	450	86	78
60-13	150	32	13
	250	47	40
	350	75	50
	450	78	70

Composition applied	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
60-14	150	27	20
	250	75	53
	350	82	70
	450	92	67
60-15	150	70	20
	250	78	30
	350	92	80
	450	93	80
60-16	150	68	40
	250	73	30
	350	93	80
	450	93	77
60-17	150	73	20
	250	85	30
	350	93	60
	450	95	63

Compositions 60-16 and 60-17, containing steareth-20 and oleth-20 respectively, exhibited very high herbicidal activity on ABUTH. At the very high surfactant to glyphosate a.e. ratio (1:1) of these compositions, no difference was evident between these compositions and an otherwise similar composition (60-15) containing Neodol 25-20 in place of steareth-20 or oleth-20.

EXAMPLE 61

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 61a. All are oil-in-water emulsions and were prepared by process (vii).

Table 61a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
61-01	163	1.00	10.0	Tween 80
61-02	163	1.00	10.0	Neodol 25-12
61-03	163	1.00	10.0	Neodol 25-20
61-04	163	1.00	10.0	steareth-20
61-05	163	1.00	10.0	oleth-20
61-06	163	1.00	10.0	Tergitol 15-S-40
61-07	163	1.00	10.0	Tergitol 15-S-15
61-08	163	1.00	10.0	Tergitol 15-S-20
61-09	163	0.50	10.0	Tergitol 15-S-40
61-10	163	0.50	10.0	Tergitol 15-S-15
61-11	163	0.50	10.0	Tergitol 15-S-20
61-12	163	0.50	5.0	Tergitol 15-S-40
61-13	163	0.50	5.0	Tergitol 15-S-15
61-14	163	0.50	5.0	Tergitol 15-S-20
61-15	163	0.25	10.0	Tergitol 15-S-40

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 19 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 61b.

Table 61b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	2	20
	250	2	30
	350	5	53
	450	45	75
Formulation C	150	45	63
	250	77	93
	350	83	99
	450	93	100
Formulation J	150	15	40
	250	70	73
	350	78	98
	450	92	99
61-01	150	42	50
	250	72	89
	350	80	96
	450	93	98
61-02	150	45	80
	250	72	83
	350	85	91
	450	97	98
61-03	150	60	80
	250	75	87
	350	82	96
	450	86	99
61-04	150	65	60
	250	82	70
	350	93	80
	450	98	87
61-05	150	72	60
	250	83	87
	350	95	93
	450	98	97
61-06	150	50	45
	250	68	70
	350	77	85
	450	83	90

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
61-07	150	25	40
	250	65	50
	350	80	77
	450	83	80
61-08	150	37	33
	250	72	80
	350	77	87
	450	80	90
61-09	150	32	47
	250	65	73
	350	77	75
	450	80	94
61-10	150	17	30
	250	65	70
	350	75	70
	450	78	89
61-11	150	35	33
	250	68	68
	350	77	77
	450	92	75
61-12	150	13	35
	250	57	40
	350	75	57
	450	77	83
61-13	150	35	40
	250	63	43
	350	77	77
	450	83	75
61-14	150	30	25
	250	67	53
	350	78	85
	450	83	77
61-15	150	13	37
	250	65	50
	350	77	57
	450	87	82

At a surfactant to glyphosate a.e. weight/weight ratio of about 1:1.5, compositions containing steareth-20 or oleth-20 (61-04 and 61-05 respectively) exhibited herbicidal effectiveness on ABUTH similar to one containing Neodol 25-20 (61-03).

EXAMPLE 62

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 62a. All are oil-in-water emulsions and were prepared by process (vii).

Table 62a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
62-01	163	1.0	10.0	Tween 80
62-02	163	1.0	10.0	Neodol 25-12
62-03	163	1.0	10.0	Neodol 25-20
62-04	163	1.0	10.0	steareth-20
62-05	163	1.0	10.0	oleth-20
62-06	163	1.0	10.0	Tergitol 15-S-40
62-06	163	1.0	10.0	Tergitol 15-S-15
62-08	163	1.0	10.0	Tergitol 15-S-20
62-09	163	0.5	10.0	Tergitol 15-S-40
62-10	163	0.3	10.0	Tergitol 15-S-15
62-11	163	0.3	10.0	Tergitol 15-S-20
62-12	163	0.3	10.0	Tergitol 15-S-40
62-13	163	0.3	5.0	Tergitol 15-S-15
62-14	163	0.3	5.0	Tergitol 15-S-20
62-15	163	0.3	5.0	Tergitol 15-S-40

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 21 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 62b.

Table 62b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	23
	250	0	40
	350	5	53
	450	13	57
Formulation C	150	0	47
	250	28	87
	350	72	98
	450	97	97
Formulation J	150	5	40
	250	20	63
	350	67	93
	450	82	92
62-01	150	2	40
	250	30	50
	350	50	70
	450	57	85

Concentrate composition	Glyphosate rate g a.c./ha	% Inhibition	
		ABUTH	ECHCF
62-02	150	10	50
	250	33	50
	350	75	72
	450	75	88
62-03	150	17	53
	250	60	60
	350	70	92
	450	78	94
62-04	150	57	45
	250	70	70
	350	82	93
	450	83	95
62-05	150	47	45
	250	70	80
	350	80	88
	450	88	92
62-06	150	2	42
	250	20	60
	350	35	75
	450	58	89
62-07	150	0	42
	250	30	68
	350	40	75
	450	77	82
62-08	150	2	40
	250	25	60
	350	50	83
	450	75	86
62-09	150	2	43
	250	27	83
	350	40	73
	450	70	78
62-10	150	2	42
	250	32	47
	350	43	63
	450	70	82
62-11	150	0	30
	250	25	53
	350	35	75
	450	70	75
62-12	150	2	40
	250	13	57
	350	25	75
	450	40	83
62-13	150	5	42
	250	23	62
	350	38	63
	450	67	60

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
62-14	150	2	33
	250	13	48
	350	30	53
	450	70	88
62-15	150	2	33
	250	18	48
	350	30	75
	450	43	65

In this test, herbicidal effectiveness overall was lower than in the previous Example, particularly on ABUTH. In these circumstances, at a surfactant to glyphosate a.e. weight/weight ratio of about 1:1.5, compositions containing steareth-20 or oleth-20 (62-04 and 62-05 respectively) exhibited greater herbicidal effectiveness on both ABUTH and ECHCF than one containing Neodol 25-20 (62-03).

EXAMPLE 63

Aqueous concentrate compositions were prepared containing glyphosate ammonium or IPA salt and excipient ingredients as shown in Table 63a. Concentrate composition 63-01 is a water-in-oil-in-water multiple emulsion and was prepared by process (vi), using Span 80 as emulsifier #1. Concentrate compositions 63-02 to 63-11 and 63-17 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 63-12 to 63-16 are aqueous solution concentrates and were prepared by process (viii), the component indicated below as "emulsifier #2" being the surfactant component.

Table 63a

Conc. comp.	% w/w				% in inner aq. phase		Emulsifier #2	Glyphosate salt
	Glyphos-ate a.e.	Butyl stearate	Span 80	Emulsifier #2	Water	Glyphosate		
63-01	10	18.0	3.0	5.0	9.0	20	Tween 20	IPA
63-02	15	1.0		10.0			Tween 80	IPA
63-03	15	1.0		10.0			Neodol 25-12	IPA
63-04	15	1.0		10.0			Neodol 25-20	IPA
63-05	15	1.0		10.0			steareth-20	IPA
63-06	15	1.0		10.0			oleth-20	IPA
63-07	15	1.0		10.0			Tween 80	ammonium
63-08	15	1.0		10.0			Neodol 25-12	ammonium
63-09	15	1.0		10.0			Neodol 25-20	ammonium
63-10	15	1.0		10.0			steareth-20	ammonium
63-11	15	1.0		10.0			oleth-20	ammonium
63-12	15			10.0			Tween 80	IPA
63-13	15			10.0			Neodol 25-12	IPA
63-14	15			10.0			Neodol 25-20	IPA
63-15	15			10.0			steareth-20	IPA
63-16	15			10.0			oleth-20	IPA
63-17	15	1.0		10.0			Emerest 2661	IPA

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 20 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 63b.

Table 63b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	2	5
	250	3	25
	350	28	30
	450	53	50
Formulation C	150	5	25
	250	60	50
	350	85	83
	450	88	88
Formulation J	150	2	10
	250	70	40
	350	82	53
	450	87	83
63-01	150	23	20
	250	72	30
	350	80	80
	450	85	69
63-02	150	5	18
	250	72	38
	350	82	63
	450	85	83
63-03	150	25	20
	250	70	57
	350	85	68
	450	90	83
63-04	150	25	27
	250	77	67
	350	85	62
	450	88	70
63-05	150	60	25
	250	82	62
	350	87	73
	450	85	80
63-06	150	50	32
	250	78	78
	350	91	91
	450	98	98

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition ABUTH	ECHCF
63-07	150	5	25
	250	55	77
	350	77	86
	450	83	99
63-08	150	0	13
	250	58	78
	350	80	85
	450	85	87
63-09	150	7	25
	250	57	72
	350	77	83
	450	91	92
63-10	150	50	25
	250	80	55
	350	86	87
	450	92	82
63-11	150	53	30
	250	78	80
	350	87	89
	450	95	98
63-12	150	0	25
	250	50	77
	350	77	90
	450	83	94
63-13	150	2	30
	250	55	75
	350	72	92
	450	85	80
63-14	150	12	30
	250	75	78
	350	84	90
	450	96	94
63-15	150	55	35
	250	78	80
	350	80	94
	450	86	98
63-16	150	50	35
	250	73	63
	350	84	83
	450	89	95
63-17	150	0	10
	250	10	53
	350	53	83
	450	62	87

Compositions containing steareth-20 or oleth-20 (63-05, 63-06, 63-10, 63-11, 63-15, 63-16) generally exhibited superior herbicidal effectiveness to counterparts containing Neodol 25-20 (63-04, 63-

09, 63-14), at least on ABUTH. The presence of a small amount of butyl stearate tended to enhance effectiveness on ABUTH (compare 63-05 and 63-06 with 63-15 and 63-16).

EXAMPLE 64

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 64a. Concentrate composition 64-01 is a water-in-oil-in-water multiple emulsion and was prepared by process (vi), using Span 80 as emulsifier #1. Concentrate compositions 64-02 to 64-08, 64-14, 64-16 and 64-17 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 64-09 to 64-13 and 64-15 are aqueous solution concentrates and were prepared by process (viii), the component indicated below as "emulsifier #2" being the surfactant component.

Table 64a

Conc. comp.	% w/w				% in inner aq. phase		Emulsifier #2
	Glyphosate a.e.	Butyl stearate	Span 80	Emulsifier #2	Water	Glyphosate	
64-01	10	18.0	3.0	2.5	9.0	20	Tween 20
64-02	15	1.0		10.0			Emerest 2661
64-03	15	1.0		10.0			Tween 80
64-04	15	1.0		10.0			oleth-20
64-05	15	1.0		10.0			Neodol 25-20
64-06	15	1.0		10.0			ceteareth-27
64-07	15	1.0		10.0			ceteareth-55
64-08	15	1.0		10.0			Genapol UD-110
64-09	15			10.0			ceteareth-27
64-10	15			10.0			ceteareth-55
64-11	15			10.0			Genapol UD-110
64-12	15			10.0			oleth-20
64-13	10			10.0			oleth-20
64-14	10	1.0		10.0			oleth-20
64-15	20			10.0			oleth-20
64-16	15	0.5		5.0			oleth-20
64-17	15	0.5		10.0			oleth-20

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 64b.

Table 64b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition ABUTH	% Inhibition ECHCF
Formulation B	150	0	0
	250	8	20
	350	27	40
	450	62	50
Formulation C	150	27	50
	250	75	70
	350	92	80
	450	97	92
Formulation J	150	23	30
	250	72	50
	350	94	63
	450	95	80
64-01	150	22	30
	250	60	40
	350	83	57
	450	90	67
64-02	150	12	33
	250	45	50
	350	73	63
	450	83	83
64-03	150	27	43
	250	68	50
	350	80	63
	450	87	87
64-04	150	68	47
	250	95	73
	350	99	78
	450	95	90
64-05	150	50	50
	250	77	77
	350	90	83
	450	98	83
64-06	150	78	67
	250	93	82
	350	97	87
	450	99	97
64-07	150	87	57
	250	96	73
	350	99	85
	450	99	97
64-08	150	42	30
	250	73	53
	350	82	85
	450	95	89

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
64-09	150	67	40
	250	95	73
	350	99	95
	450	99	98
64-10	150	85	60
	250	96	68
	350	96	91
	450	100	88
64-11	150	13	10
	250	67	50
	350	78	60
	450	88	73
64-12	150	72	43
	250	97	68
	350	98	83
	450	99	93
64-13	150	73	57
	250	88	70
	350	98	87
	450	99	96
64-14	150	80	50
	250	96	70
	350	99	85
	450	98	88
64-15	150	70	43
	250	96	53
	350	97	82
	450	99	89
64-16	150	62	53
	250	88	72
	350	99	81
	450	99	91
64-17	150	72	58
	250	95	68
	350	100	89
	450	100	93

The greatest herbicidal effectiveness in this test was exhibited by compositions containing a C_{16-18} alkylether surfactant (oleth-20, ceteareth-27 or ceteareth-55).

EXAMPLE 65

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 65a. All are oil-in-water emulsions and were prepared by process (vii).

Table 65a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
65-01	163	1.00	10.0	Tween 80
65-02	163	1.00	10.0	Emerest 2661
65-03	326	1.00	10.0	Genapol UD-110
65-04	326	0.50	10.0	Genapol UD-110
65-05	326	0.25	10.0	Genapol UD-110
65-06	163	0.25	10.0	Genapol UD-110
65-07	163	1.00	10.0	Genapol UD-110
65-08	163	1.00	10.0	Neodol 1-9
65-09	163	1.00	10.0	Neodol 1-12
65-10	163	1.00	10.0	Neodol 25-20
65-11	163	1.00	10.0	Neodol 25-12
65-12	163	1.00	10.0	Neodox 25-11
65-13	163	1.00	10.0	laureth-23
65-14	163	1.00	10.0	ceteth-20
65-15	163	1.00	10.0	steareth-20
65-16	163	1.00	10.0	oleth-20

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 15 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 23 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 65b.

Table 65b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	0
	250	25	22
	350	60	40
	450	65	52
Formulation C	150	43	52
	250	72	83
	350	87	98
	450	97	95
Formulation J	150	50	43
	250	75	91
	350	86	96
	450	95	97
65-01	150	50	30
	250	75	75
	350	85	87
	450	90	92

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
65-02	150	35	47
	250	58	77
	350	75	85
	450	80	96
65-03	150	33	32
	250	57	53
	350	75	78
	450	84	94
65-04	150	20	25
	250	55	68
	350	78	91
	450	82	97
65-05	150	37	12
	250	58	42
	350	81	70
	450	86	73
65-06	150	50	8
	250	65	40
	350	81	65
	450	92	85
65-07	150	50	30
	250	63	48
	350	84	68
	450	98	84
65-08	150	43	35
	250	52	65
	350	73	85
	450	84	85
65-09	150	55	40
	250	68	58
	350	79	65
	450	97	73
65-10	150	69	40
	250	81	68
	350	94	92
	450	99	96
65-11	150	58	50
	250	84	60
	350	90	83
	450	94	93
65-12	150	50	40
	250	57	67
	350	65	84
	450	75	98
65-13	150	57	53
	250	78	73
	350	89	97
	450	98	97

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
65-14	150	68	67
	250	85	73
	350	97	98
	450	100	97
65-15	150	72	50
	250	88	89
	350	89	98
	450	99	97
65-16	150	65	53
	250	87	72
	350	97	85
	450	100	95

Activity overall in this test was very high, and differences among compositions in herbicidal effectivess are difficult to discern clearly.

EXAMPLE 66

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 66a. All are oil-in-water emulsions and were prepared by process (vii). The pH of all compositions was approximately 5.

Table 66a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl Stearate	Surfactant	
66-01	163	1.00	10.0	Tween 80
66-02	163	1.00	10.0	Emerest 2661
66-03	163	1.00	10.0	Neodol 25-20
66-04	163	1.00	10.0	oleth-20
66-05	163	0.50	5.0	oleth-20
66-06	163	0.25	2.5	oleth-20
66-07	163	0.50	2.5	oleth-20
66-08	163	0.50	1.0	oleth-20
66-09	163	0.25	5.0	oleth-20
66-10	326	1.00	10.0	Neodol 1-12
66-11	326	0.50	10.0	Neodol 1-12
66-12	326	0.25	10.0	Neodol 1-12
66-13	326	1.00	5.0	Neodol 1-12
66-14	326	0.50	5.0	Neodol 1-12
66-15	326	0.25	5.0	Neodol 1-12
66-16	326	0.10	5.0	Neodol 1-12

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray

compositions were made 15 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 20 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 66b.

Table 66b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	7	50
	250	45	60
	350	73	73
	450	80	78
Formulation C	150	75	77
	250	87	100
	350	96	99
	450	99	97
Formulation J	150	72	77
	250	83	89
	350	97	99
	450	97	98
66-01	150	60	75
	250	80	85
	350	93	97
	450	98	98
66-02	150	57	75
	250	70	83
	350	87	83
	450	90	94
66-03	150	77	80
	250	87	92
	350	97	87
	450	99	98
66-04	150	80	89
	250	93	92
	350	99	99
	450	100	99
66-05	150	83	83
	250	92	93
	350	97	90
	450	100	93
66-06	150	77	77
	250	80	91
	350	90	99
	450	98	99
66-07	150	77	83
	250	82	89
	350	90	91
	450	97	98

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
66-08	150	47	82
	250	73	82
	350	80	97
	450	92	91
66-09	150	73	78
	250	87	88
	350	97	94
	450	99	99
66-10	150	52	67
	250	70	80
	350	93	88
	450	93	94
66-11	150	40	68
	250	72	85
	350	87	96
	450	93	96
66-12	150	37	60
	250	68	83
	350	85	85
	450	93	75
66-13	150	28	63
	250	53	80
	350	85	97
	450	88	97
66-14	150	37	63
	250	58	73
	350	83	96
	450	90	91
66-15	150	30	70
	250	47	83
	350	82	89
	450	87	89
66-16	150	40	53
	250	53	82
	350	80	80
	450	88	77

Composition 66-04, containing 1% butyl stearate and 10% oleth-20 (surfactant to glyphosate a.e. weight/weight ratio about 1:1.5), exhibited marginally greater herbicidal effectiveness than composition 66-03, containing 1% butyl stearate and 10% Neodol 25-20. At this very high surfactant to glyphosate ratio, however, both performed extremely well. Surprisingly, when the butyl stearate and oleth-20 concentrations were significantly lowered, this high level of performance was maintained to a remarkable degree. Even when butyl stearate was reduced to 0.25% and oleth-20 to 2.5% (surfactant to

glyphosate a.e. ratio about 1:6), as in composition 66-06, herbicidal effectiveness was still similar to that obtained with commercial standard Formulations C and J.

EXAMPLE 67

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 67a. Concentrate compositions 67-01 to 67-08 and 67-11 to 67-16 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 67-09 and 67-10 are aqueous solution concentrates and were prepared by process (viii). The pH of all compositions was approximately 5.

Table 67a

Concentrate composition	% w/w			Type of surfactant
	Glyphosate a.e.	Butyl stearate	Surfactant	
67-01	15.0	0.25	5.0	Emerest 2661
67-02	15.0	0.25	5.0	Tween 80
67-03	15.0	0.25	5.0	Neodol 25-20
67-04	15.0	0.25	5.0	laureth-23
67-05	15.0	0.25	5.0	ceteth-20
67-06	15.0	0.25	2.5	Tween 80
67-07	15.0	0.10	1.0	Tween 80
67-08	15.0	1.00	10.0	Tween 80
67-09	15.0		5.0	laureth-23
67-10	15.0		5.0	ceteth-20
67-11	15.0	1.00	10.0	Neodol 25-20
67-12	15.0	1.00	10.0	oleth-20
67-13	15.0	0.50	5.0	oleth-20
67-14	15.0	0.25	5.0	oleth-20
67-15	15.0	0.25	2.5	oleth-20
67-16	15.0	0.25	5.0	Genapol UD-110

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 12 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 16 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 67b.

Table 67b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	2	10
	250	5	20
	350	43	30
	450	58	43

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation C	150	68	50
	250	92	79
	350	96	90
	450	98	85
Formulation J	150	57	43
	250	90	63
	350	95	80
	450	95	95
67-01	150	7	33
	250	50	43
	350	77	53
	450	80	93
67-02	150	17	50
	250	72	70
	350	80	80
	450	80	93
67-03	150	43	40
	250	75	68
	350	87	75
	450	96	95
67-04	150	33	47
	250	73	63
	350	80	77
	450	90	93
67-05	150	73	37
	250	92	57
	350	95	88
	450	95	73
67-06	150	25	35
	250	68	47
	350	80	92
	450	88	85
67-07	150	3	30
	250	57	40
	350	77	53
	450	80	67
67-08	150	53	43
	250	77	62
	350	80	88
	450	93	80
67-09	150	32	60
	250	77	53
	350	93	73
	450	97	93
67-10	150	75	35
	250	92	77
	350	96	77
	450	97	93

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
67-11	150	75	53
	250	90	78
	350	95	89
	450	98	97
67-12	150	80	43
	250	95	73
	350	96	92
	450	98	89
67-13	150	75	53
	250	92	97
	350	97	99
	450	96	93
67-14	150	78	70
	250	90	92
	350	93	97
	450	95	93
67-15	150	70	60
	250	83	98
	350	95	99
	450	97	99
67-16	150	27	52
	250	75	73
	350	80	98
	450	83	99

Extremely high herbicidal effectiveness was again observed with a composition (67-15) containing 15% glyphosate a.e. and just 2.5% oleth-20 together with 0.25% butyl stearate. A comparison of 15% glyphosate a.e. compositions containing 5% alkylether surfactant and 0.25% butyl stearate provided the following ranking of alkylethers in descending order of effectiveness: oleth-20 (67-14) > ceteth-20 (67-05) > Neodol 25-20 (67-03) = laureth-23 (67-04).

EXAMPLE 68

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 68a. All are oil-in-water emulsions and were prepared by process (vii).

Table 68a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
68-01	163	0.50	5.0	oleth-20
68-02	163	0.25	5.0	oleth-20
68-03	163	0.25	2.5	oleth-20
68-04	163	1.00	10.0	oleth-20
68-05	163	0.50	5.0	steareth-20
68-06	163	0.25	5.0	steareth-20
68-07	163	0.25	2.5	steareth-20

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
68-08	163	1.00	10.0	steareth-20

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 16 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 68b.

Table 68b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	30
	250	20	43
	350	43	53
	450	68	57
Formulation C	150	60	47
	250	75	53
	350	87	80
	450	87	78
Formulation J	150	42	43
	250	83	60
	350	87	73
	450	93	87
68-01	150	60	60
	250	78	63
	350	87	89
	450	92	78
68-02	150	70	43
	250	80	91
	350	87	86
	450	96	87
68-03	150	52	43
	250	75	72
	350	83	93
	450	87	94
68-04	150	72	50
	250	93	73
	350	97	95
	450	97	91
68-05	150	72	43
	250	80	78
	350	87	91
	450	93	85

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
68-06	150	68	40
	250	80	50
	350	93	75
	450	95	85
68-07	150	63	37
	250	78	55
	350	87	84
	450	83	82
68-08	150	70	50
	250	80	70
	350	92	84
	450	94	98

All compositions containing butyl stearate and either oleth-20 or steareth-20 showed a very high level of performance by comparison with commercial standard Formulations C and J.

EXAMPLE 69

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 69a. All are oil-in-water emulsions and were prepared by process (vii).

Table 69a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
69-01	163	0.50	5.0	oleth-20
69-02	163	0.25	5.0	oleth-20
69-03	163	0.25	2.5	oleth-20
69-04	163	1.00	10.0	oleth-20
69-05	163	0.50	5.0	steareth-20
69-06	163	0.25	5.0	steareth-20
69-07	163	0.25	2.5	steareth-20
69-08	163	1.00	10.0	steareth-20

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 69b.

Table 69b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	3	10
	250	28	23
	350	72	37
	450	73	50
Formulation C	150	57	43
	250	87	62
	350	93	83
	450	99	95
Formulation J	150	27	47
	250	70	53
	350	92	75
	450	94	92
69-01	150	68	50
	250	85	47
	350	97	70
	450	99	83
69-02	150	67	40
	250	78	50
	350	96	63
	450	99	68
69-03	150	52	40
	250	72	50
	350	95	63
	450	97	85
69-04	150	72	40
	250	97	53
	350	97	77
	450	99	90
69-05	150	75	40
	250	missing	53
	350	88	53
	450	96	78
69-06	150	98	40
	250	93	50
	350	97	68
	450	97	82
69-07	150	73	40
	250	92	50
	350	98	63
	450	98	80
69-08	150	77	43
	250	93	57
	350	97	77
	450	98	88

All compositions containing butyl stearate and either oleth-20 or steareth-20 showed a very high level of performance by comparison with commercial standard Formulations C and J.

EXAMPLE 70

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 70a. All contain colloidal particulates and were prepared by process (ix).

All compositions of this example showed acceptable storage stability. The compositions containing oleth-20 were not acceptably storage-stable in the absence of the colloidal particulate.

Table 70a

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of Aerosil
		Butyl stearate	Oleth-20	Aerosil	
70-01	488		3.0	0.4	OX-50
70-02	488		3.0	0.8	OX-50
70-03	488		3.0	1.5	OX-50
70-04	488			0.4	OX-50
70-05	488			0.8	OX-50
70-06	488			1.5	OX-50
70-07	488		3.0	0.4	MOX-80
70-08	488		3.0	0.8	MOX-80
70-09	488		3.0	1.5	MOX-80
70-10	488			0.4	MOX-80
70-11	488			0.8	MOX-80
70-12	488			1.5	MOX-80
70-13	488		3.0	0.4	MOX-170
70-14	488		3.0	0.8	MOX-170
70-15	488		3.0	1.5	MOX-170
70-16	488			0.4	MOX-170
70-17	488			0.8	MOX-170
70-18	488			1.5	MOX-170
70-19	488	3.0	3.0	1.5	MOX-80

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 20 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 70b.

Table 70b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	27
	250	17	37
	350	47	57
	450	60	60

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation J	150	57	50
	250	82	87
	350	95	99
	450	98	99
70-01	150	37	60
	250	73	70
	350	96	97
	450	96	99
70-02	150	43	50
	250	73	63
	350	93	96
	450	98	99
70-03	150	53	60
	250	83	87
	350	87	97
	450	98	98
70-04	150	45	40
	250	57	60
	350	78	95
	450	94	100
70-05	150	47	50
	250	60	82
	350	92	96
	450	95	99
70-06	150	38	53
	250	68	96
	350	82	99
	450	83	95
70-07	150	50	57
	250	87	88
	350	91	99
	450	98	98
70-08	150	53	50
	250	88	85
	350	96	97
	450	97	100
70-09	150	40	30
	250	37	47
	350	57	80
	450	77	94
70-10	150	47	50
	250	70	95
	350	75	99
	450	77	98
70-11	150	27	60
	250	72	85
	350	82	98
	450	75	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition ABUTH	% Inhibition ECHCF
70-12	150	37	57
	250	73	86
	350	80	99
	450	85	100
70-13	150	45	53
	250	85	94
	350	95	100
	450	98	99
70-14	150	50	50
	250	78	83
	350	94	98
	450	98	99
70-15	150	53	67
	250	75	88
	350	93	97
	450	96	99
70-16	150	42	50
	250	47	96
	350	70	98
	450	90	99
70-17	150	27	83
	250	57	98
	350	87	99
	450	87	100
70-18	150	33	60
	250	47	94
	350	83	99
	450	93	99
70-19	150	45	47
	250	80	73
	350	96	94
	450	99	98

Remarkably high levels of herbicidal effectiveness were obtained in this test with compositions containing oleth-20 at a weight/weight ratio to glyphosate a.e. of about 1:14, and stabilized with colloidal particulates. In some cases the colloidal particulate alone contributed a major part of the efficacy enhancement. Results with composition 70-09 are out of line with other data and an application problem is suspected.

EXAMPLE 71

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 71a. Concentrate compositions 71-01 to 71-04, 71-06, 71-08, 71-09, 71-11, 71-12, 71-14 and 71-16 are oil-in-water emulsions and were prepared by process (vii). Concentrate

compositions 71-05, 71-07, 71-10, 71-13, 71-15 and 71-17 are aqueous solution concentrates and were prepared by process (viii).

Table 71a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
71-01	163	0.25	2.5	Neodol 1-12
71-02	163	0.25	2.5	laureth-23
71-03	163	0.25	2.5	steareth-10
71-04	163	0.25	2.5	steareth-20
71-05	163		2.5	steareth-20
71-06	163	0.25	2.5	steareth-100
71-07	163		2.5	steareth-100
71-08	163	0.25	2.5	oleth-10
71-09	163	0.25	2.5	oleth-20
71-10	163		2.5	oleth-20
71-11	163	0.25	2.5	ceteth-10
71-12	163	0.25	2.5	ceteth-20
71-13	163		2.5	ceteth-20
71-14	326	0.50	5.0	ceteareth-27
71-15	326		5.0	ceteareth-27
71-16	163	0.25	2.5	ceteareth-55
71-17	163		2.5	ceteareth-55

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 15 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 71b.

Table 71b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	33
	250	20	43
	350	63	63
	450	75	70
Formulation C	150	53	55
	250	80	87
	350	94	97
	450	98	99
Formulation J	150	40	57
	250	80	90
	350	96	99
	450	98	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
71-01	150	52	40
	250	65	73
	350	77	70
	450	77	70
71-02	150	37	70
	250	75	80
	350	83	97
	450	95	99
71-03	150	47	53
	250	77	86
	350	83	97
	450	93	100
71-04	150	80	60
	250	93	83
	350	96	85
	450	99	99
71-05	150	80	43
	250	93	79
	350	96	94
	450	98	96
71-06	150	77	53
	250	85	83
	350	94	99
	450	97	99
71-07	150	63	50
	250	80	88
	350	85	96
	450	96	99
71-08	150	27	45
	250	75	83
	350	77	99
	450	96	98
71-09	150	75	57
	250	80	82
	350	97	95
	450	99	98
71-10	150	70	40
	250	85	83
	350	97	98
	450	99	99
71-11	150	53	37
	250	75	63
	350	88	93
	450	92	98
71-12	150	70	40
	250	78	75
	350	90	91
	450	98	98

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
71-13	150	72	40
	250	92	80
	350	97	90
	450	99	97
71-14	150	78	53
	250	89	88
	350	97	95
	450	99	100
71-15	150	80	60
	250	95	97
	350	98	100
	450	99	99
71-16	150	60	63
	250	87	78
	350	96	94
	450	98	99
71-17	150	73	60
	250	85	57
	350	93	80
	450	99	85

In combination with butyl stearate, steareth-20 (composition 71-04) gave greater herbicidal effectiveness than steareth-10 (71-03) on ABUTH. Similarly, oleth-20 (71-09) was more efficacious than oleth-10 (71-08) and ceteth-20 (71-12) than ceteth-10 (71-11). In the absence of butyl stearate, ceteareth-55 (71-17) was noticeably weaker on ECHCF than ceteareth-27 (71-15) but inclusion of butyl stearate (71-16) tended to correct this weakness. Note that while compositions 71-14 and 71-15 contained twice as high a concentration of excipients as the other compositions of the test, the concentration of glyphosate was also twice as high, thus the concentrations as sprayed were the same.

EXAMPLE 72

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 72a. Concentrate compositions 72-01 to 72-05, 72-07, 72-08, 72-10 and 72-12 to 72-16 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 72-06, 72-09 and 72-11 are aqueous solution concentrates and were prepared by process (viii).

Table 72a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
72-01	163	0.25	2.5	Neodol 1-12
72-02	163	0.25	2.5	laureth-23
72-03	163	0.25	2.5	steareth-10
72-04	163	0.25	2.5	steareth-20
72-05	163	0.25	2.5	Pluronic F-68

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
72-06	163		2.5	Pluronic F-68
72-07	326	1.00	5.0	Pluronic F-108
72-08	326	0.50	5.0	Pluronic F-108
72-09	326		5.0	Pluronic F-108
72-10	163	0.25	2.5	Pluronic F-127
72-11	163		2.5	Pluronic F-127
72-12	326	0.50	5.0	ceteareth-27
72-13	163	0.25	2.5	ceteareth-55
72-14	163	0.25	2.5	oleth-20
72-15	163	0.25	2.5	ceteth-20
72-16	163	0.25	2.5	steareth-100

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 15 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 72b.

Table 72b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	5	0
	250	47	5
	350	70	23
	450	75	43
Formulation C	150	73	47
	250	99	50
	350	98	67
	450	99	75
Formulation J	150	73	43
	250	89	50
	350	97	83
	450	98	77
72-01	150	37	30
	250	70	33
	350	77	40
	450	90	47
72-02	150	52	37
	250	77	67
	350	90	77
	450	92	75

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
72-03	150	40	30
	250	77	70
	350	80	82
	450	90	83
72-04	150	75	37
	250	95	53
	350	99	91
	450	99	82
72-05	150	58	37
	250	65	53
	350	80	80
	450	75	68
72-06	150	40	30
	250	75	33
	350	78	43
	450	80	43
72-07	150	50	30
	250	75	33
	350	78	53
	450	86	53
72-08	150	47	30
	250	75	33
	350	77	40
	450	80	50
72-09	150	43	33
	250	77	40
	350	78	63
	450	83	50
72-10	150	27	40
	250	77	43
	350	80	50
	450	92	40
72-11	150	37	30
	250	72	33
	350	80	60
	450	95	40
72-12	150	78	37
	250	98	40
	350	99	53
	450	100	50
72-13	150	75	30
	250	88	40
	350	98	47
	450	100	65
72-14	150	73	30
	250	87	40
	350	98	50
	450	99	53

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
72-15	150	72	30
	250	93	40
	350	96	43
	450	99	50
72-16	150	73	40
	250	83	40
	350	98	40
	450	100	47

Composition 72-04 containing steareth-20 outperformed its counterpart 72-03 containing steareth-10, though both gave greater herbicidal effectiveness, especially on ECHCF, than 72-02 containing laureth-23 or 72-01 containing Neodol 1-12.

EXAMPLE 73

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 73a. Concentrate compositions 73-01 to 73-07 and 73-09 to 73-15 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 73-08 and 73-16 are aqueous solution concentrates and were prepared by process (viii).

Table 73a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of oil	Type of surfactant
		Oil	Surfactant		
73-01	163	0.5	5.0	methyl stearate	oleth-20
73-02	163	0.5	5.0	butyl stearate	oleth-20
73-03	163	0.5	5.0	methyl oleate	oleth-20
73-04	163	0.5	5.0	butyl oleate	oleth-20
73-05	163	0.5	5.0	methyl laurate	oleth-20
73-06	163	0.5	5.0	butyl laurate	oleth-20
73-07	163	0.5	5.0	Orchex 796	oleth-20
73-08	163		5.0	none	oleth-20
73-09	163	0.5	5.0	methyl stearate	Neodol 1-9
73-10	163	0.5	5.0	butyl stearate	Neodol 1-9
73-11	163	0.5	5.0	methyl oleate	Neodol 1-9
73-12	163	0.5	5.0	butyl oleate	Neodol 1-9
73-13	163	0.5	5.0	methyl laurate	Neodol 1-9
73-14	163	0.5	5.0	butyl laurate	Neodol 1-9
73-15	163	0.5	5.0	Orchex 796	Neodol 1-9
73-16	163		5.0	none	Neodol 1-9

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 19 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 73b.

Table 73b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	3	10
	250	58	57
	350	78	53
	450	77	53
Formulation C	150	60	98
	250	87	99
	350	95	98
	450	99	100
Formulation J	150	60	75
	250	89	87
	350	93	90
	450	98	99
73-01	150	75	96
	250	99	97
	350	97	99
	450	99	100
73-02	150	60	60
	250	97	67
	350	99	98
	450	100	95
73-03	150	63	40
	250	83	82
	350	97	86
	450	97	88
73-04	150	73	40
	250	94	82
	350	97	100
	450	99	100
73-05	150	67	47
	250	86	67
	350	97	88
	450	99	100
73-06	150	60	43
	250	78	91
	350	97	83
	450	94	86
73-07	150	70	53
	250	80	53
	350	97	82
	450	97	92
73-08	150	70	62
	250	83	83
	350	91	87
	450	98	98

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
73-09	150	45	42
	250	72	72
	350	77	73
	450	78	89
73-10	150	40	30
	250	82	80
	350	78	98
	450	89	93
73-11	150	40	30
	250	65	60
	350	77	90
	450	96	92
73-12	150	20	30
	250	63	73
	350	80	75
	450	93	86
73-13	150	20	27
	250	67	60
	350	82	91
	450	88	92
73-14	150	7	30
	250	72	81
	350	87	78
	450	80	85
73-15	150	20	23
	250	65	60
	350	77	81
	450	87	88
73-16	150	12	30
	250	57	53
	350	68	85
	450	85	85

Composition 73-08, containing as sole excipient substance oleth-20 at a 1:3 weight/weight ratio to glyphosate a.e., exhibited high herbicidal effectiveness, at least equal to commercial standard Formulations C and J on ABUTH but a little weaker on ECHCF. By comparison, composition 73-16, wherein the sole excipient substance was Neodol 1-9 at the same ratio to glyphosate, had much weaker activity. Addition of a small amount of fatty acid ester in most cases enhanced effectiveness, especially on ECHCF. In this study the most efficacious composition was 73-01, containing oleth-20 and methyl stearate. When added to Neodol 1-9, butyl stearate was more efficacious than methyl stearate, methyl oleate or butyl oleate. The mineral oil Orchex 796 did not substitute effectively for butyl stearate, either with oleth-20 or with Neodol 1-9.

EXAMPLE 74

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 74a. Concentrate compositions 74-01, 74-03, 74-05 to 74-08, 74-10 and 74-14 to 74-17 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 74-02, 74-04, 74-09 and 74-11 to 74-13 are aqueous solution concentrates and were prepared by process (viii). Some compositions contained a coupling agent as indicated in Table 74a; the coupling agent was added with the surfactant.

Table 74a

Conc. comp.	Glyphosate g a.e./l	% w/w			Type of coupling agent	Type of surfactant
		Butyl stearate	Surfactant	Coupling agent		
74-01	326	1.0	5.0	2.5	Arcosolve DPM	oleth-20
74-02	326		5.0	2.5	Arcosolve DPM	oleth-20
74-03	163	0.5	2.5		none	oleth-20
74-04	163		2.5		none	oleth-20
74-05	326	1.0	5.0		none	ceteareth-27
74-06	326	1.0	5.0	2.5	PEG-400	ceteareth-27
74-07	326	1.0	5.0	2.5	Dowanol TPNB	ceteareth-27
74-08	326	1.0	5.0	2.5	Dowanol PNB	ceteareth-27
74-09	163		2.5		none	ceteareth-27
74-10	326	0.5	5.0		none	ceteareth-27
74-11	326		5.0	2.5	PEG-400	ceteareth-27
74-12	326		5.0	2.5	Dowanol TPNB	ceteareth-27
74-13	326		5.0	2.5	Dowanol PNB	ceteareth-27
74-14	163	0.5	2.5		none	Neodol 1-9
74-15	163	0.5	2.5		none	laureth-23
74-16	163	0.5	2.5		none	steareth-20
74-17	163	0.5	2.5		none	ceteareth-27

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 74b.

Table 74b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	0	5
	250	38	20
	350	63	30
	450	70	70

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation C	150	70	75
	250	92	94
	350	99	99
	450	99	98
Formulation J	150	65	50
	250	88	92
	350	97	99
	450	98	97
74-01	150	58	83
	250	77	88
	350	93	96
	450	93	99
74-02	150	40	76
	250	75	100
	350	92	100
	450	92	100
74-03	150	48	75
	250	83	96
	350	92	100
	450	99	100
74-04	150	40	82
	250	78	99
	350	87	99
	450	98	100
74-05	150	68	92
	250	87	99
	350	95	99
	450	99	99
74-06	150	55	60
	250	83	99
	350	97	99
	450	98	98
74-07	150	63	57
	250	80	96
	350	95	97
	450	99	98
74-08	150	73	75
	250	90	90
	350	95	97
	450	100	97
74-09	150	73	68
	250	87	73
	350	92	90
	450	97	95
74-10	150	70	63
	250	87	80
	350	98	94
	450	99	96

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
74-11	150	73	60
	250	90	77
	350	99	93
	450	100	95
74-12	150	72	67
	250	83	75
	350	90	82
	450	99	94
74-13	150	73	70
	250	80	83
	350	99	94
	450	100	92
74-14	150	5	20
	250	55	63
	350	77	93
	450	78	99
74-15	150	43	57
	250	78	88
	350	88	98
	450	90	98
74-16	150	65	57
	250	83	82
	350	88	98
	450	95	97
74-17	150	72	50
	250	80	93
	350	88	90
	450	95	97

The superiority of herbicidal effectiveness provided by C_{16-18} alkylethers (oleth-20, ceteareth-27, steareth-20) over that provided by shorter chain alkylethers (Neodol 1-9, laureth-23) was very pronounced in this test.

EXAMPLE 75

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 75a. Concentrate compositions 75-01 to 75-07 and 75-09 to 75-15 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 75-08 and 75-16 are aqueous solution concentrates and were prepared by process (viii).

Table 75a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of oil	Type of surfactant
		Oil	Surfactant		
75-01	163	0.5	5.0	methyl stearate	steareth-20
75-02	163	0.5	5.0	butyl stearate	steareth-20
75-03	163	0.5	5.0	methyl oleate	steareth-20
75-04	163	0.5	5.0	butyl oleate	steareth-20

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of oil	Type of surfactant
		Oil	Surfactant		
75-05	163	0.5	5.0	methyl laurate	steareth-20
75-06	163	0.5	5.0	butyl laurate	steareth-20
75-07	163	0.5	5.0	Orchex 796	steareth-20
75-08	163		5.0	none	steareth-20
75-09	163	0.5	5.0	methyl stearate	ceteareth-27
75-10	163	0.5	5.0	butyl stearate	ceteareth-27
75-11	163	0.5	5.0	methyl oleate	ceteareth-27
75-12	163	0.5	5.0	butyl oleate	ceteareth-27
75-13	163	0.5	5.0	methyl laurate	ceteareth-27
75-14	163	0.5	5.0	butyl laurate	ceteareth-27
75-15	163	0.5	5.0	Orchex 796	ceteareth-27
75-16	163		5.0	none	ceteareth-27

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 19 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 75b.

Table 75b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	15	5
	250	57	20
	350	83	50
	450	78	73
Formulation C	150	65	63
	250	87	93
	350	92	94
	450	98	100
Formulation J	150	50	73
	250	90	90
	350	94	98
	450	98	99
75-01	150	72	70
	250	88	85
	350	96	83
	450	99	86
75-02	150	73	53
	250	83	87
	350	97	99
	450	97	98

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
75-03	150	68	33
	250	87	92
	350	93	97
	450	98	93
75-04	150	72	50
	250	87	88
	350	94	86
	450	98	97
75-05	150	72	67
	250	83	82
	350	99	97
	450	98	98
75-06	150	73	33
	250	95	83
	350	99	95
	450	99	88
75-07	150	73	55
	250	93	73
	350	95	83
	450	98	91
75-08	150	75	40
	250	94	60
	350	98	86
	450	99	92
75-09	150	77	50
	250	90	50
	350	98	92
	450	99	98
75-10	150	72	53
	250	92	77
	350	96	86
	450	99	99
75-11	150	72	60
	250	87	87
	350	97	97
	450	97	99
75-12	150	70	57
	250	90	90
	350	96	96
	450	98	99
75-13	150	68	40
	250	90	77
	350	99	95
	450	99	98
75-14	150	77	33
	250	94	70
	350	96	82
	450	99	93

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
75-15	150	75	30
	250	96	75
	350	97	88
	450	99	92
75-16	150	77	40
	250	99	47
	350	98	67
	450	98	78

Steareth-20 and ceteareth-27, as sole excipient substances (compositions 75-08 and 75-16 respectively) provided excellent herbicidal effectiveness, but further enhancements, especially on ECHCF, were obtained by inclusion of a small amount of fatty acid ester in the composition.

EXAMPLE 76

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 76a. Concentrate compositions 76-13 and 76-14 are aqueous solution concentrates and were prepared by process (viii). Concentrate compositions 76-01 to 76-12 and 76-15 are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix). Concentrate compositions 76-16 and 76-17 contained colloidal particulates but no surfactant.

Compositions 76-13 and 76-14 (both containing 162 g a.e./l glyphosate) showed acceptable storage stability. However, at glyphosate loadings >480 g a.e./l (as in compositions 76-01 to 76-12 and 76-15) storage-stable compositions containing 3% oleth-20 could not be made except with the addition of colloidal particulate as shown below.

Table 76a

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of Aerosil
		Oleth-20	Glycerin	Aerosil	
76-01	492	3.00	2.0	0.8	380
76-02	492	3.00	5.0	1.5	380
76-03	492	3.00	2.0	0.8	380
76-04	492	3.00	5.0	1.5	380
76-05	492	3.00		0.8	OX-50
76-06	492	3.00		1.5	OX-50
76-07	492	3.00		0.8	380/OX-50 blend
76-08	492	3.00		1.5	380/OX-50 blend
76-09	492	3.00		0.8	380
76-10	492	3.00		1.5	380
76-11	492	3.00		0.8	380
76-12	492	3.00		1.5	380
76-13	162	1.13			none
76-14	162	1.13			none
76-15	492	3.00	2.0	1.5	380
76-16	488			0.8	380
76-17	488			1.5	380

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 76b.

Table 76b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	18	40
	250	57	53
	350	72	63
	450	83	85
Formulation J	150	70	65
	250	85	95
	350	98	98
	450	100	99
76-01	150	62	67
	250	72	93
	350	99	96
	450	99	97
76-02	150	57	50
	250	70	91
	350	92	97
	450	99	99
76-03	150	48	40
	250	68	67
	350	97	97
	450	98	98
76-04	150	55	50
	250	82	83
	350	95	90
	450	99	94
76-05	150	65	43
	250	87	87
	350	100	94
	450	96	95
76-06	150	55	53
	250	75	82
	350	95	95
	450	100	96
76-07	150	45	83
	250	78	82
	350	90	93
	450	95	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
76-08	150	55	47
	250	75	88
	350	93	99
	450	99	97
76-09	150	47	47
	250	65	82
	350	78	99
	450	97	97
76-10	150	47	40
	250	72	96
	350	77	80
	450	85	97
76-11	150	37	53
	250	73	82
	350	80	83
	450	90	92
76-12	150	35	57
	250	70	82
	350	80	97
	450	90	99
76-13	150	50	40
	250	68	75
	350	95	92
	450	99	95
76-14	150	40	33
	250	70	82
	350	93	89
	450	98	93
76-15	150	23	33
	250	67	73
	350	83	91
	450	94	92
76-16	150	13	40
	250	45	50
	350	62	72
	450	77	77
76-17	150	7	33
	250	50	50
	350	60	70
	450	75	73

Several high-loaded (492 g a.e./l) glyphosate compositions containing oleth-20 at just 3% exhibited surprisingly high herbicidal effectiveness, approaching or equalling that of commercial standard Formulation J, which is loaded at only about 360 g a.e./l and has a much higher surfactant to glyphosate ratio.

EXAMPLE 77

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 77a. Concentrate composition 77-08 to 77-14 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 77-15 to 77-17 are aqueous solution concentrates and were prepared by process (viii). Concentrate compositions 77-01 to 77-07 contain colloidal particulates and were prepared by process (ix).

Compositions 77-08 to 77-17 (all containing 163 g a.e./l glyphosate) showed acceptable storage stability. However, at a glyphosate loading of 400 g a.e./l (as in compositions 77-01 to 77-07) storage-stable compositions containing 0.5-1% butyl stearate and 5-10% alkylether surfactant could not be made except with the addition of colloidal particulate as shown below.

Table 77a

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of surfactant
		Butyl stearate	Surfactant	Aerosil 90	
77-01	400	1.0	10.0	1.0	ceteareth-27
77-02	400	1.0	10.0	1.0	steareth-20
77-03	400	0.5	5.0	1.0	ceteareth-27
77-04	400	0.5	5.0	1.0	steareth-20
77-05	400	1.0	5.0	1.0	ceteareth-27
77-06	400	1.0	5.0	1.0	steareth-20
77-07	400	1.0	5.0	1.0	steareth-30
77-08	163	0.5	5.0		oleth-20
77-09	163	0.5	5.0		steareth-20
77-10	163	0.5	5.0		ceteth-20
77-11	163	0.5	5.0		laureth-23
77-12	163	0.5	5.0		ceteareth-27
77-13	163	0.5	5.0		Neodol 25-12
77-14	163	0.5	5.0		Neodol 25-20
77-15	163		5.0		steareth-20
77-16	163		5.0		ceteth-20
77-17	163		5.0		laureth-23

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 18 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 19 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 77b.

Table 77b

Composition applied	Glyphosate rate g a.e./ha	% Inhibition ABUTH	% Inhibition ECHCF
Formulation B	150	0	40
	250	20	60
	350	68	82
	450	83	96
Formulation C	150	68	93
	250	93	99
	350	100	100
	450	100	100
Formulation J	150	43	89
	250	93	100
	350	100	100
	450	100	100
77-01	150	78	97
	250	96	100
	350	98	100
	450	100	100
77-02	150	91	98
	250	100	100
	350	100	100
	450	100	100
77-03	150	90	97
	250	99	99
	350	100	100
	450	100	100
77-04	150	77	98
	250	100	100
	350	100	100
	450	100	100
77-05	150	82	93
	250	100	99
	350	100	100
	450	100	100
77-06	150	83	85
	250	100	99
	350	100	100
	450	100	100
77-07	150	83	87
	250	100	100
	350	100	100
	450	100	100
77-08	150	90	92
	250	100	100
	350	100	100
	450	100	100

Composition applied	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
77-09	150	90	85
	250	100	98
	350	100	100
	450	100	100
77-10	150	80	85
	250	100	92
	350	100	100
	450	100	100
77-11	150	83	88
	250	96	99
	350	100	98
	450	100	100
77-12	150	93	85
	250	100	99
	350	100	100
	450	100	100
77-13	150	72	73
	250	92	97
	350	100	99
	450	100	100
77-14	150	72	80
	250	99	99
	350	100	100
	450	100	100
77-15	150	100	93
	250	100	99
	350	100	100
	450	100	100
77-16	150	100	98
	250	100	100
	350	100	100
	450	100	100
77-17	150	83	83
	250	100	99
	350	100	99
	450	100	99

Outstanding herbicidal effectiveness was provided by compositions containing C_{16-18} alkylether surfactants (ceteareth-27, steareth-20, steareth-30, oleth-20, ceteth-20). High-loaded (400 g a.e./l) glyphosate compositions containing a C_{16-18} alkylether surfactant, butyl stearate and a colloidal particulate (Aerosil 90) to stabilize the compositions performed especially impressively in this test.

EXAMPLE 78

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 78a. Concentrate composition 78-01 to 78-09, 78-11 to 78-14, 78-16 and

78-17 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 78-10 and 78-15 are aqueous solution concentrates and were prepared by process (viii).

Table 78a

Conc. comp.	Glyphosate g a.e./l	% w/w			Type of oil	Other surfactant
		Oil	Oleth-20	Other surfactant		
78-01	163	0.25	2.5		methyl laurate	
78-02	163	0.25	2.5		methyl myristate	
78-03	163	0.25	2.5		methyl palmitoleate	
78-04	163	0.25	2.5		methyl palmitate	
78-05	163	0.25	2.5		methyl linoleate	
78-06	163	0.25	2.5		methyl oleate	
78-07	163	0.25	2.5		methyl stearate	
78-08	163	0.25	2.5		ethyl stearate	
78-09	163	0.25	2.5		butyl stearate	
78-10	163		2.5		none	
78-11	163	0.25		2.5	methyl palmitoleate	MON 0818
78-12	163	0.25		2.5	methyl palmitate	MON 0818
78-13	163	0.25		2.5	methyl oleate	MON 0818
78-14	163	0.25		2.5	methyl stearate	MON 0818
78-15	163			2.5	none	MON 0818
78-16	163	0.25		2.5	butyl stearate	laureth-23
78-17	163	0.25		2.5	butyl stearate	Neodol 1-9

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 20 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 16 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 78b.

Table 78b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	2	35
	200	52	67
	300	77	83
	400	78	87
Formulation C	100	25	77
	200	72	99
	300	87	100
	400	99	100
Formulation J	100	13	73
	200	70	97
	300	90	100
	400	97	100

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
78-01	100	22	55
	200	65	86
	300	78	98
	400	89	98
78-02	100	20	63
	200	67	91
	300	83	99
	400	97	100
78-03	100	30	75
	200	63	98
	300	83	99
	400	94	100
78-04	100	23	63
	200	60	98
	300	90	99
	400	95	100
78-05	100	27	57
	200	62	91
	300	83	96
	400	93	98
78-06	100	23	50
	200	63	89
	300	83	99
	400	96	99
78-07	100	25	53
	200	65	94
	300	83	99
	400	92	99
78-08	100	13	47
	200	53	88
	300	89	97
	400	95	99
78-09	100	27	53
	200	60	85
	300	83	97
	400	97	98
78-10	100	13	53
	200	62	94
	300	83	97
	400	88	99
78-11	100	23	60
	200	50	90
	300	85	98
	400	95	99
78-12	100	17	55
	200	35	94
	300	78	98
	400	94	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
78-13	100	8	50
	200	43	90
	300	73	98
	400	90	99
78-14	100	30	63
	200	45	92
	300	80	98
	400	94	98
78-15	100	20	63
	200	70	96
	300	82	99
	400	94	98
78-16	100	18	62
	200	62	83
	300	80	97
	400	97	97
78-17	100	17	52
	200	58	85
	300	75	90
	400	95	98

No great or consistent enhancement of herbicidal effectiveness of glyphosate compositions containing oleth-20 was obtained by adding a small amount of any of a variety of fatty acid esters in this study (compare 78-10 with 78-01 to 78-09).

EXAMPLE 79

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 79a. Concentrate composition 79-01 to 79-09, 79-11 to 79-14, 79-16 and 79-17 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 79-10 and 79-15 are aqueous solution concentrates and were prepared by process (viii).

Table 79a

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of oil	Other surfactant
		Oil	Oleth-20	Other surfactant		
79-01	163	0.25	2.5		isopropyl myristate	
79-02	163	0.25	2.5		ethyl myristate	
79-03	163	0.25	2.5		methyl palmitate	
79-04	163	0.25	2.5		ethyl palmitate	
79-05	163	0.25	2.5		ethyl linoleate	
79-06	163	0.25	2.5		ethyl oleate	
79-07	163	0.25	2.5		methyl stearate	
79-08	163	0.25	2.5		ethyl stearate	
79-09	163	0.25	2.5		butyl stearate	
79-10	163		2.5		none	
79-11	163	0.25		2.5	methyl palmitate	MON 0818

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of oil	Other surfactant
		Oil	Oleth-20	Other surfactant		
79-12	163	0.25		2.5	methyl stearate	MON 0818
79-13	163	0.25		2.5	ethyl stearate	MON 0818
79-14	163	0.25		2.5	ethyl oleate	MON 0818
79-15	163			2.5	none	MON 0818
79-16	163	0.25		2.5	butyl stearate	laureth-23
79-17	163	0.25		2.5	butyl stearate	Neodol 1-9

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 19 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 79b.

Table 79b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	12	33
	200	45	43
	300	73	63
	400	80	63
Formulation C	100	43	57
	200	75	88
	300	95	99
	400	100	99
Formulation J	100	53	60
	200	77	75
	300	96	95
	400	99	98
79-01	100	35	40
	200	73	72
	300	83	91
	400	99	97
79-02	100	38	30
	200	70	43
	300	87	82
	400	96	80
79-03	100	25	27
	200	68	50
	300	90	73
	400	96	82
79-04	100	27	27
	200	75	50
	300	80	73
	400	96	80

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
79-05	100	33	27
	200	68	43
	300	83	70
	400	97	91
79-06	100	33	28
	200	72	53
	300	83	60
	400	99	70
79-07	100	37	25
	200	72	40
	300	83	50
	400	97	65
79-08	100	32	25
	200	73	43
	300	87	60
	400	98	67
79-09	100	35	25
	200	75	43
	300	95	57
	400	98	63
79-10	100	35	27
	200	73	40
	300	83	76
	400	97	73
79-11	100	35	33
	200	67	67
	300	80	86
	400	92	70
79-12	100	25	30
	200	67	70
	300	83	76
	400	88	80
79-13	100	27	33
	200	70	66
	300	78	63
	400	93	60
79-14	100	33	30
	200	67	47
	300	80	70
	400	92	77
79-15	100	20	30
	200	68	40
	300	83	75
	400	90	72
79-16	100	30	25
	200	62	43
	300	73	73
	400	77	70

Concentrate composition	Glyphosate rate g a.c./ha	% Inhibition	
		ABUTH	ECHCF
79-17	100	30	23
	200	58	40
	300	75	60
	400	80	73

In this study, isopropyl myristate (composition 79-01) was the most effective of the fatty acid esters tested as additives to oleth-20 (79-10) in glyphosate compositions.

EXAMPLE 80

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 80a. Concentrate composition 80-01 to 80-13 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 80-14 to 80-17 are aqueous solution concentrates and were prepared by process (viii).

Table 80a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of oil	Type of surfactant
		Oil	Surfactant		
80-01	163	0.25	2.5	butyl stearate	laureth-23
80-02	163	0.25	2.5	butyl stearate	steareth-20
80-03	163	0.25	2.5	butyl stearate	ceteareth-20
80-04	163	0.25	2.5	butyl stearate	ceteareth-15
80-05	163	0.25	2.5	butyl stearate	Neodol 45-13
80-06	163	0.25	2.5	methyl stearate	steareth-20
80-07	163	0.25	2.5	methyl stearate	ceteareth-20
80-08	163	0.25	2.5	methyl stearate	ceteareth-15
80-09	163	0.25	2.5	methyl stearate	Neodol 45-13
80-10	163	0.25	2.5	methyl palmitate	steareth-20
80-11	163	0.25	2.5	methyl palmitate	ceteareth-20
80-12	163	0.25	2.5	methyl palmitate	ceteareth-15
80-13	163	0.25	2.5	methyl palmitate	Neodol 45-13
80-14	163		2.5	none	steareth-20
80-15	163		2.5	none	ceteareth-20
80-16	163		2.5	none	ceteareth-15
80-17	163		2.5	none	Neodol 45-13

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 24 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 16 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 80b.

Table 80b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	10	37
	200	30	40
	300	43	57
	400	23	33
Formulation C	100	50	67
	200	75	96
	300	85	99
	400	94	100
Formulation J	100	40	75
	200	73	94
	300	93	98
	400	95	99
80-01	100	63	77
	200	67	94
	300	77	99
	400	88	96
80-02	100	63	75
	200	83	88
	300	93	98
	400	95	99
80-03	100	67	75
	200	82	95
	300	95	99
	400	98	99
80-04	100	60	75
	200	82	97
	300	96	99
	400	98	100
80-05	100	63	73
	200	75	89
	300	80	98
	400	87	97
80-06	100	58	63
	200	78	93
	300	93	99
	400	98	100
80-07	100	60	67
	200	78	93
	300	93	99
	400	100	99
80-08	100	missing	missing
	200	missing	missing
	300	78	95
	400	98	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
80-09	100	23	30
	200	65	83
	300	80	98
	400	93	99
80-10	100	65	67
	200	83	95
	300	97	99
	400	99	99
80-11	100	72	73
	200	90	98
	300	96	97
	400	99	99
80-12	100	68	63
	200	90	92
	300	98	99
	400	97	99
80-13	100	43	73
	200	72	87
	300	83	98
	400	93	96
80-14	100	62	77
	200	78	99
	300	95	99
	400	98	100
80-15	100	52	60
	200	78	93
	300	94	98
	400	97	99
80-16	100	38	68
	200	68	99
	300	87	97
	400	94	99
80-17	100	55	75
	200	68	91
	300	83	96
	400	87	98

Herbicidal effectiveness exceeding that of commercial standard composition J, at least on ABUTH, was recorded with several compositions, including 80-02 (steareth-20 plus butyl stearate), 80-03 (ceteareth-20 plus butyl stearate), 80-04 (ceteareth-15 plus butyl stearate), 80-10 (steareth-20 plus methyl palmitate), 80-11 (ceteareth-20 plus methyl palmitate) and 80-12 (ceteareth-15 plus methyl palmitate). Compositions lacking fatty acid ester performed slightly less well overall than those containing butyl stearate or methyl palmitate.

EXAMPLE 81

Spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 81a. Compositions were prepared by simple mixing of ingredients. Soybean lecithin (45% phospholipid, Avanti), where included, was first prepared with sonication in water to make a homogeneous composition. Four different concentrations of glyphosate (not shown in Table 81a) were prepared, calculated to provide, when applied in a spray volume of 93 l/ha, the glyphosate rates shown in Table 81b.

Table 81a

Spray comp.	% w/w					Lecithin supplied as	Methyl oleate supplied as
	Lecithin	FC-754	Butyl stearate	Methyl oleate	Oleth-20		
81-01	0.05	0.050				soybean lecithin	
81-02	0.05		0.050			soybean lecithin	
81-03	0.05					soybean lecithin	
81-04		0.050					
81-05			0.050				
81-06	0.05					LI-700	
81-07			0.005		0.05		
81-08				0.01	0.05		
81-09					0.05		
81-10			0.005				
81-11				0.01			pure
81-12				0.01			methylated seed oil

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and Prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH, 14 days after planting ECHCF and 21 days after planting SIDSP. Evaluation of herbicidal inhibition was done 14 days after application.

Formulations B and C were applied as comparative treatments, representing technical glyphosate IPA salt and a commercial formulation of glyphosate IPA salt respectively. Results, averaged for all replicates of each treatment, are shown in Table 81b.

Table 81b

Composition applied	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Formulation B (technical)	50	0	0	0
	100	38	35	35
	200	87	50	90
	300	95	88	94
Formulation C (commercial)	50	0	2	0
	100	32	55	25
	200	85	97	93
	300	96	99	96

Composition applied	Glyphosate rate g a.e./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
81-01	50	78	53	88
	100	90	60	95
	200	99	96	99
	300	99	97	98
81-02	50	25	15	43
	100	72	30	82
	200	94	62	93
	300	95	77	94
81-03	50	20	8	32
	100	52	22	78
	200	87	55	91
	300	95	65	93
81-04	50	62	37	85
	100	82	68	92
	200	97	96	95
	300	98	95	97
81-05	50	15	10	25
	100	47	27	23
	200	85	62	87
	300	90	63	92
81-06	50	0	2	0
	100	20	15	20
	200	85	60	82
	300	90	65	90
81-07	50	67	27	82
	100	87	55	93
	200	94	92	96
	300	97	99	97
81-08	50	62	30	75
	100	78	63	91
	200	93	96	96
	300	94	98	98
81-09	50	65	45	77
	100	80	73	95
	200	93	98	97
	300	95	99	99
81-10	50	10	25	5
	100	23	35	37
	200	90	50	93
	300	92	73	94
81-11	50	10	25	0
	100	52	33	43
	200	88	72	93
	300	94	78	94
81-12	50	0	15	0
	100	43	35	33
	200	91	70	90
	300	94	82	93

Results of this test using glyphosate as the exogenous chemical are summarized as follows:

At the low concentration of 0.05% used here, soybean lecithin containing 45% phospholipid (81-03) was a much more effective excipient than the lecithin-based adjuvant LI-700 (81-06) widely used in the art.

Butyl stearate alone at 0.05% (81-05) did not greatly enhance effectiveness.

The combination of lecithin and butyl stearate (81-02) gave surprisingly strong enhancement of effectiveness, suggesting a synergistic interaction between these two excipient substances.

Fluorad FC-754, either alone (81-04) or in combination with lecithin (81-01) gave extremely high effectiveness, superior to that obtained with the commercial standard.

Oleth-20 at the low concentration of 0.05% (81-09) gave extremely high effectiveness, superior to that obtained with the commercial standard. Addition of 0.005% butyl stearate (81-07) or 0.01% methyl oleate (81-08) did not provide further enhancement.

EXAMPLE 82

Spray compositions were prepared containing paraquat dichloride and excipient ingredients. Compositions 82-01 to 82-12 were exactly like compositions 81-01 to 81-12 except that a different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH, 8 days after planting ECHCF and 21 days after planting SIDSP. Evaluation of herbicidal inhibition was done 12 days after application.

Standards included technical paraquat dichloride and Gramoxone, a commercial formulation of paraquat from Zeneca. Results, averaged for all replicates of each treatment, are shown in Table 82.

Table 82

Spray composition	Paraquat rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Paraquat dichloride (technical)	25	50	83	55
	50	57	78	60
	100	73	84	69
	200	85	95	99
Gramoxone (commercial)	25	40	72	40
	50	60	70	52
	100	72	58	55
	200	72	89	63
82-01	25	75	93	67
	50	82	97	91
	100	95	98	97
	200	100	99	99

Spray composition	Paraquat rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
82-02	25	67	80	48
	50	68	87	65
	100	88	97	93
	200	96	99	98
82-03	25	55	65	42
	50	62	87	65
	100	83	96	93
	200	95	99	97
82-04	25	53	82	45
	50	63	94	53
	100	88	99	86
	200	92	99	98
82-05	25	58	67	50
	50	60	62	45
	100	70	73	62
	200	85	90	88
82-06	25	53	77	43
	50	60	92	40
	100	80	93	55
	200	96	99	78
82-07	25	65	80	45
	50	82	92	70
	100	96	96	89
	200	100	98	99
82-08	25	67	80	37
	50	82	90	71
	100	97	98	65
	200	99	99	93
82-09	25	72	90	50
	50	80	97	57
	100	91	99	94
	200	97	100	97
82-10	25	67	87	45
	50	68	75	57
	100	78	93	63
	200	82	97	82
82-11	25	65	80	45
	50	73	77	62
	100	90	95	62
	200	94	98	78
82-12	25	67	78	37
	50	75	90	55
	100	77	97	90
	200	85	99	92

Results of this test using paraquat as the exogenous chemical are summarized as follows:

At the low concentration of 0.05% used here, soybean lecithin containing 45% phospholipid (82-03) was a much more effective excipient on SIDSP than the lecithin-based adjuvant LI-700 (82-06) widely used in the art.

Butyl stearate alone at 0.05% (82-05) did not enhance effectiveness.

The combination of lecithin and butyl stearate (82-02) gave surprisingly strong enhancement of effectiveness, suggesting a synergistic interaction between these two excipient substances.

Fluorad FC-754 (82-04) gave extremely high effectiveness, superior to that obtained with the commercial standard. In the presence of lecithin (82-01), effectiveness was further increased dramatically, suggesting a synergistic interaction between these two excipient substances.

Oleth-20 at the low concentration of 0.05% (82-09) gave extremely high effectiveness, superior to that obtained with the commercial standard. Addition of 0.005% butyl stearate (82-07) or 0.01% methyl oleate (82-08) did not provide further enhancement.

EXAMPLE 83

Spray compositions were prepared containing acifluorfen sodium salt and excipient ingredients. Compositions 83-01 to 83-12 were exactly like compositions 81-01 to 81-12 respectively except that a different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 15 days after planting ABUTH, 9 days after planting ECHCF and 22 days after planting SIDSP. Evaluation of herbicidal inhibition was done 10 days after application.

Standards included technical acifluorfen sodium and Blazer, a commercial formulation of acifluorfen from Rohm & Haas. Results, averaged for all replicates of each treatment, are shown in Table 83.

Table 83

Spray composition	Acifluorfen rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Acifluorfen (technical)	25	20	2	15
	50	32	7	17
	100	52	18	35
	200	62	35	40
Blazer (commercial)	25	30	30	5
	50	53	53	12
	100	55	55	7
	200	65	65	32
83-01	25	60	7	20
	50	63	20	20
	100	65	43	33
	200	80	70	48

Spray composition	Acifluorfen rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
83-02	25	25	7	5
	50	42	12	25
	100	60	30	22
	200	68	68	50
83-03	25	22	5	10
	50	55	7	33
	100	62	25	27
	200	65	55	48
83-04	25	57	7	13
	50	67	10	32
	100	67	35	32
	200	70	70	45
83-05	25	30	3	15
	50	47	27	27
	100	55	42	37
	200	65	60	38
83-06	25	28	0	3
	50	50	0	10
	100	55	30	25
	200	67	58	47
83-07	25	35	20	17
	50	55	35	27
	100	58	63	32
	200	67	67	55
83-08	25	40	20	8
	50	57	30	28
	100	60	60	30
	200	70	77	48
83-09	25	47	20	22
	50	55	35	35
	100	62	65	38
	200	68	82	50
83-10	25	28	0	5
	50	48	0	10
	100	53	5	25
	200	62	35	40
83-11	25	35	0	5
	50	43	0	30
	100	50	0	35
	200	65	43	47
83-12	25	40	5	5
	50	55	18	35
	100	60	47	38
	200	70	62	48

Results of this test using acifluorfen as the exogenous chemical are summarized as follows:

At the low concentration of 0.05% used here, soybean lecithin containing 45% phospholipid (83-03) gave effectiveness similar to that obtained with the lecithin-based adjuvant LI-700 (83-06) widely used in the art.

Butyl stearate at 0.05% alone (83-05) and in combination with lecithin (83-02) enhanced effectiveness, particularly on ECHCF.

Fluorad FC-754, either alone (83-04) or in combination with lecithin (83-01) gave effectiveness on ABUTH and SIDSP superior to that obtained with the commercial standard.

Oleth-20 at the low concentration of 0.05% (83-09) gave effectiveness superior to that obtained with the commercial standard. Addition of 0.005% butyl stearate (83-07) or 0.01% methyl oleate (83-08) did not provide further enhancement.

EXAMPLE 84

Spray compositions were prepared containing asulam and excipient ingredients. Compositions 84-01 to 84-12 were exactly like compositions 81-01 to 81-12 respectively except that a different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH, 11 days after planting ECHCF and 21 days after planting SIDSP. Evaluation of herbicidal inhibition was done 14 days after application.

Standards included technical asulam and Asulox, a commercial formulation of asulam from Rhône-Poulenc. Results, averaged for all replicates of each treatment, are shown in Table 84.

Table 84

Spray composition	Asulam rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Asulam (technical)	200	0	12	0
	400	17	27	5
	800	48	32	20
	1400	42	50	37
Asulox (commercial)	200	3	5	0
	400	27	30	20
	800	52	45	25
	1400	50	60	40
84-01	200	5	8	13
	400	23	45	22
	800	50	50	30
	1400	60	65	48
84-02	200	0	20	17
	400	33	40	20
	800	47	48	33
	1400	53	68	55

Spray composition	Asulam rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
84-03	200	3	20	3
	400	28	52	7
	800	50	50	23
	1400	50	58	43
84-04	200	3	40	7
	400	35	45	18
	800	52	50	25
	1400	58	60	42
84-05	200	0	10	3
	400	23	30	18
	800	33	50	32
	1400	45	57	38
84-06	200	2	30	10
	400	8	47	17
	800	50	55	28
	1400	52	63	40
84-07	200	0	43	3
	400	22	48	17
	800	40	55	28
	1400	52	60	33
84-08	200	7	47	22
	400	20	48	22
	800	53	55	30
	1400	57	60	33
84-09	200	0	45	7
	400	25	50	7
	800	53	60	32
	1400	55	63	37
84-10	200	22	37	10
	400	27	45	10
	800	50	43	23
	1400	52	52	27
84-11	200	25	33	5
	400	15	37	13
	800	48	42	25
	1400	42	52	28
84-12	200	3	25	17
	400	13	42	18
	800	50	45	30
	1400	52	50	33

Results of this test using asulam as the exogenous chemical are summarized as follows:

At the low concentration of 0.05% used here, soybean lecithin containing 45% phospholipid (84-03) gave similar enhancement to that obtained with the lecithin-based adjuvant LI-700 (84-06) widely used in the art.

Butyl stearate alone at 0.05% (84-05) enhanced effectiveness on ECHCF.

The combination of lecithin and butyl stearate (84-02) gave greater enhancement of effectiveness than either excipient substance alone.

Fluorad FC-754, either alone (84-04) or in combination with lecithin (84-01) gave effectiveness equal to that obtained with the commercial standard.

Oleth-20 at the low concentration of 0.05% (84-09) gave, at low exogenous chemical rates, effectiveness on ECHCF superior to that obtained with the commercial standard. Addition of 0.005% butyl stearate (84-07) or 0.01% methyl oleate (84-08) did not provide further enhancement.

EXAMPLE 85

Spray compositions were prepared containing dicamba sodium salt and excipient ingredients. Compositions 85-01 to 85-12 were exactly like compositions 81-01 to 81-12 respectively except that a different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH, 8 days after planting ECHCF and 21 days after planting SIDSP. Evaluation of herbicidal inhibition was done 17 days after application.

Standards included technical dicamba sodium and Banvel, a commercial formulation of dicamba from Sandoz. Results, averaged for all replicates of each treatment, are shown in Table 85.

Table 85

Spray composition	Dicamba rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Dicamba (technical)	25	47	0	30
	50	63	0	40
	100	82	0	50
	200	93	5	58
Banvel (commercial)	25	47	0	35
	50	68	0	40
	100	91	0	53
	200	93	3	63
85-01	25	42	0	38
	50	67	0	48
	100	92	0	67
	200	93	3	73
85-02	25	43	0	43
	50	58	0	50
	100	85	0	62
	200	89	8	72
85-03	25	50	0	32
	50	65	0	45
	100	90	0	60
	200	94	13	68

Spray composition	Dicamba rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
85-04	25	43	0	35
	50	65	0	42
	100	94	0	53
	200	94	13	67
85-05	25	50	0	35
	50	68	0	40
	100	88	0	53
	200	92	15	60
85-06	25	40	0	40
	50	65	0	45
	100	88	0	52
	200	92	8	70
85-07	25	45	0	42
	50	57	0	45
	100	88	0	62
	200	88	20	68
85-08	25	40	0	38
	50	62	0	45
	100	97	18	62
	200	93	17	73
85-09	25	33	0	35
	50	60	0	45
	100	93	0	63
	200	96	15	73
85-10	25	35	0	30
	50	57	0	43
	100	90	0	50
	200	90	3	70
85-11	25	45	0	30
	50	53	0	42
	100	89	0	55
	200	92	0	73
85-12	25	38	0	37
	50	60	0	45
	100	96	0	52
	200	93	0	70

Results of this test using dicamba as the exogenous chemical are summarized as follows:

At the low concentration of 0.05% used here, soybean lecithin containing 45% phospholipid (85-03) gave similar enhancement of effectiveness to that obtained with the lecithin-based adjuvant LI-700 (85-06) widely used in the art.

Butyl stearate alone at 0.05% (85-05) provided slight enhancement of effectiveness.

The combination of lecithin and butyl stearate (85-02) gave greater enhancement of effectiveness on SIDSP than either of these two excipient substances alone.

Fluorad FC-754 (85-04) provided effectiveness similar to that obtained with the commercial standard. Further enhancement on SIDSP was obtained with the combination of Fluorad FC-754 and lecithin (85-01).

Oleth-20 at the low concentration of 0.05% (85-09) gave effectiveness on SIDSP superior to that obtained with the commercial standard. Addition of 0.005% butyl stearate (85-07) or 0.01% methyl oleate (85-08) did not provide significant further enhancement.

EXAMPLE 86

Spray compositions were prepared containing metsulfuron-methyl and excipient ingredients. Compositions 86-01 to 86-12 were exactly like compositions 81-01 to 81-12 respectively except that a different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH, 8 days after planting ECHCF and 21 days after planting SIDSP. Evaluation of herbicidal inhibition was done 14 days after application.

Standards included technical metsulfuron-methyl and Ally, a commercial formulation of metsulfuron from Du Pont. Results, averaged for all replicates of each treatment, are shown in Table 86.

Table 86

Spray composition	Metsulfuron rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Metsulfuron (technical)	0.5	72	0	5
	1	90	0	23
	5	96	0	50
	10	97	30	55
Ally (commercial)	0.5	75	0	5
	1	85	0	22
	5	95	0	42
	10	97	25	53
86-01	0.5	95	0	47
	1	96	20	53
	5	97	25	62
	10	98	45	62
86-02	0.5	87	0	40
	1	90	10	55
	5	95	10	58
	10	96	40	63
86-03	0.5	87	0	27
	1	90	0	40
	5	96	10	57
	10	97	33	63

Spray composition	Metsulfuron rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
86-04	0.5	90	0	33
	1	95	10	50
	5	98	17	62
	10	99	28	58
86-05	0.5	85	0	27
	1	90	0	33
	5	95	0	47
	10	95	13	60
86-06	0.5	77	0	30
	1	89	10	47
	5	96	17	62
	10	98	33	60
86-07	0.5	94	0	55
	1	97	10	60
	5	98	43	60
	10	97	55	65
86-08	0.5	93	0	55
	1	96	5	58
	5	97	42	60
	10	97	50	60
86-09	0.5	93	0	55
	1	97	10	62
	5	98	55	62
	10	98	65	63
86-10	0.5	85	0	28
	1	82	0	30
	5	95	10	52
	10	96	17	57
86-11	0.5	73	0	25
	1	88	20	28
	5	94	25	53
	10	96	32	57
86-12	0.5	75	0	32
	1	85	20	37
	5	94	23	55
	10	96	25	57

Results of this test using metsulfuron as the exogenous chemical are summarized as follows:

At the low concentration of 0.05% used here, soybean lecithin containing 45% phospholipid (86-03) was a slightly more effective excipient than the lecithin-based adjuvant LI-700 (86-06) widely used in the art in improving perfromance on ABUTH at the lowest exogenous chemical rate tested.

Butyl stearate alone at 0.05% (86-05) enhanced effectiveness to a level superior to that obtained with the commercial standard.

The combination of lecithin and butyl stearate (86-02) gave greater enhancement of effectiveness

than was obtained with either of these two excipient substances alone.

Fluorad FC-754, either alone (86-04) or in combination with lecithin (86-01) gave high effectiveness, superior to that obtained with the commercial standard.

Oleth-20 at the low concentration of 0.05% (86-09) gave high effectiveness, superior to that obtained with the commercial standard. Addition of 0.005% butyl stearate (86-07) or 0.01% methyl oleate (86-08) did not provide further enhancement.

EXAMPLE 87

Spray compositions were prepared containing imazethapyr and excipient ingredients. Compositions 87-01 to 87-12 were exactly like compositions 81-01 to 81-12 respectively except that a different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH, 14 days after planting ECHCF and 21 days after planting SIDSP. Evaluation of herbicidal inhibition was done 14 days after application.

Standards included technical imazethapyr and Pursuit, a commercial formulation of imazethapyr from American Cyanamid. Results, averaged for all replicates of each treatment, are shown in Table 87.

Table 87

Spray composition	Imazethapyr rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Imazethapyr (technical)	5	78	5	20
	10	83	20	30
	25	93	35	40
	50	94	53	50
Pursuit (commercial)	5	70	5	25
	10	73	33	30
	25	90	50	42
	50	93	62	57
87-01	5	70	45	35
	10	75	62	52
	25	92	63	57
	50	93	72	62
87-02	5	73	57	32
	10	75	67	43
	25	90	70	52
	50	92	72	57
87-03	5	70	42	27
	10	78	42	35
	25	90	53	45
	50	92	62	52

Spray composition	Imazethapyr rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
87-04	5	73	55	33
	10	77	68	45
	25	93	68	47
	50	94	68	60
87-05	5	73	47	32
	10	73	45	40
	25	90	62	47
	50	91	68	52
87-06	5	78	72	30
	10	83	70	35
	25	93	77	62
	50	94	78	58
87-07	5	82	75	38
	10	90	90	52
	25	93	93	53
	50	97	97	62
87-08	5	75	77	38
	10	90	92	50
	25	95	93	57
	50	97	99	63
87-09	5	78	80	40
	10	83	89	63
	25	93	93	62
	50	96	93	60
87-10	5	85	50	37
	10	77	50	45
	25	91	63	48
	50	93	75	57
87-11	5	75	38	43
	10	80	38	37
	25	92	62	45
	50	93	73	53
87-12	5	75	55	38
	10	83	60	43
	25	92	67	53
	50	93	77	55

Results of this test using imazethapyr as the exogenous chemical are summarized as follows:

At the low concentration of 0.05% used here, soybean lecithin containing 45% phospholipid (87-03) was a less effective excipient than the lecithin-based adjuvant LI-700 (87-06).

Butyl stearate alone at 0.05% (87-05) significantly enhanced effectiveness on ECHCF and slightly on SIDSP.

The combination of lecithin and butyl stearate (87-02) gave enhancement of effectiveness on ECHCF greater than that obtained with either of these two excipient substances alone.

Fluorad FC-754 (87-04) gave effectiveness on ECHCF superior to that obtained with the commercial standard. The combination of Fluorad FC-754 and lecithin (87-01) provided slight further enhancement of effectiveness on SIDSP.

Oleth-20 at the low concentration of 0.05% (87-09) gave extremely high effectiveness, greatly superior to that obtained with the commercial standard, especially on ECHCF. Addition of 0.005% butyl stearate (87-07) further enhanced performance of low exogenous chemical rates on ABUTH more effectively than addition of 0.01% methyl oleate (87-08).

EXAMPLE 88

Spray compositions were prepared containing fluazifop-p-butyl salt and excipient ingredients. Compositions 88-01 to 88-12 were exactly like compositions 81-01 to 81-12 respectively except that a different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and broadleaf signalgrass (Brachiaria platyphylla, BRAPP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 15 days after planting ABUTH, 15 days after planting ECHCF and 16 days after planting BRAPP. Evaluation of herbicidal inhibition was done 10 days after application.

Standards included technical fluazifop-p-butyl and Fusilade 5, a commercial formulation of fluazifop-p-butyl from Zeneca. Results, averaged for all replicates of each treatment, are shown in Table 88.

Table 88

Spray composition	Fluazifop-p rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	BRAPP
Fluazifop-p-butyl (technical)	2	0	0	20
	5	0	3	35
	15	5	45	65
	30	5	57	78
Fusilade 5 (commercial)	2	0	0	27
	5	0	27	33
	15	5	52	78
	30	7	75	85
88-01	2	0	0	20
	5	2	27	30
	15	5	58	78
	30	10	87	83
88-02	2	0	7	25
	5	0	35	30
	15	2	58	75
	30	8	78	75

Spray composition	Fluazifop-p rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	BRAPP
88-03	2	0	0	18
	5	0	8	27
	15	0	45	75
	30	0	55	75
88-04	2	0	20	32
	5	2	42	25
	15	2	55	72
	30	5	80	78
88-05	2	0	13	32
	5	2	42	32
	15	2	55	72
	30	7	58	73
88-06	2	2	17	23
	5	0	20	25
	15	0	50	75
	30	0	73	77
88-07	2	0	50	40
	5	0	52	60
	15	0	67	80
	30	0	92	85
88-08	2	0	43	35
	5	0	55	37
	15	7	88	82
	30	3	96	85
88-09	2	0	47	18
	5	0	50	35
	15	0	80	80
	30	3	93	85
88-10	2	0	23	10
	5	0	37	42
	15	5	55	75
	30	10	58	80
88-11	2	0	7	10
	5	0	30	28
	15	0	50	62
	30	12	53	68
88-12	2	0	5	20
	5	0	7	35
	15	5	48	68
	30	12	60	77

Results of this test using fluazifop-p-butyl as the exogenous chemical are summarized as follows:

At the low concentration of 0.05% used here, soybean lecithin containing 45% phospholipid (88-03) was a less effective excipient on ECHCF than the lecithin-based adjuvant LI-700 (88-06).

Butyl stearate alone at 0.05% (88-05) and in combination with lecithin (88-02) enhanced effectiveness, especially on ECHCF.

Fluorad FC-754, either alone (88-04) or in combination with lecithin (88-01) gave effectiveness equal or superior to that obtained with the commercial standard.

Oleth-20 at the low concentration of 0.05% (88-09) gave extremely high effectiveness on ECHCF, superior to that obtained with the commercial standard. Addition of 0.005% butyl stearate (88-07) or 0.01% methyl oleate (88-08) did not provide significant further enhancement.

EXAMPLE 89

Spray compositions were prepared containing alachlor and excipient ingredients. Compositions 89-01 to 89-12 were exactly like compositions 81-01 to 81-12 respectively except that a different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH, 8 days after planting ECHCF and 14 days after planting SIDSP. Evaluation of herbicidal inhibition was done 9 days after application.

Standards included technical alachlor and Lasso, a commercial formulation of alachlor from Monsanto Company. Results, averaged for all replicates of each treatment, are shown in Table 89.

Table 89

Spray composition	Alachlor rate g a.i./ha	% Inhibition ABUTH	ECHCF	SIDSP
Alachlor (technical)	500	0	0	0
	1000	0	0	0
	2000	0	0	0
	4000	0	0	0
Lasso (commercial)	500	0	0	0
	1000	0	5	13
	2000	0	30	17
	4000	15	43	65
89-01	500	0	0	0
	1000	0	0	0
	2000	0	0	0
	4000	10	0	7
89-02	500	0	0	0
	1000	0	0	0
	2000	0	22	7
	4000	12	47	12
89-03	500	0	0	0
	1000	0	0	0
	2000	0	0	0
	4000	10	0	0

Spray composition	Alachlor rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
89-04	500	0	0	0
	1000	0	0	0
	2000	0	0	0
	4000	5	0	15
89-05	500	0	0	0
	1000	0	0	0
	2000	0	0	0
	4000	3	0	5
89-06	500	0	0	0
	1000	0	0	0
	2000	0	13	7
	4000	0	37	12
89-07	500	0	0	0
	1000	0	8	0
	2000	0	28	15
	4000	12	50	20
89-08	500	0	0	0
	1000	0	8	0
	2000	0	8	0
	4000	5	20	5
89-09	500	0	0	0
	1000	0	0	0
	2000	0	3	0
	4000	12	42	32
89-10	500	0	0	0
	1000	0	0	0
	2000	0	0	0
	4000	0	0	0
89-11	500	0	0	0
	1000	0	0	0
	2000	0	0	0
	4000	0	0	0
89-12	500	0	0	0
	1000	0	0	0
	2000	0	0	0
	4000	0	0	0

None of the compositions tested enhanced post-emergence foliar-applied herbicidal effectiveness of alachlor in this test. Alachlor is not known as a foliar-applied herbicide.

EXAMPLE 90

Spray compositions were prepared containing glufosinate ammonium salt and excipient ingredients. Compositions 90-01 to 90-12 were exactly like compositions 81-01 to 81-12 respectively except that a different active ingredient was used and a range of active ingredient concentrations was selected appropriate to the active ingredient being applied.

Velvetleaf (Abutilon theophrasti, ABUTH), Japanese millet (Echinochloa crus-galli, ECHCF) and prickly sida (Sida spinosa, SIDSP) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 14 days after planting ABUTH, 10 days after planting ECHCF and 17 days after planting SIDSP. Evaluation of herbicidal inhibition was done 11 days after application.

Standards included technical glufosinate ammonium and Liberty, a commercial formulation of glufosinate from AgrEvo. Results, averaged for all replicates of each treatment, are shown in Table 90.

Table 90

Spray composition	Glufosinate rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
Glufosinate (technical)	50	0	0	5
	100	47	0	10
	300	90	23	96
	600	98	43	94
Liberty (commercial)	50	77	70	20
	100	88	96	93
	300	98	100	97
	600	99	100	99
90-01	50	77	33	70
	100	95	58	93
	300	98	95	97
	600	99	99	98
90-02	50	33	30	50
	100	63	32	93
	300	96	52	90
	600	98	96	97
90-03	50	15	30	38
	100	50	33	87
	300	92	40	94
	600	98	70	98
90-04	50	92	47	50
	100	90	53	85
	300	98	98	96
	600	98	99	98
90-05	50	35	20	20
	100	37	30	20
	300	97	45	78
	600	91	53	92
90-06	50	10	0	20
	100	20	3	20
	300	89	47	82
	600	91	94	89
90-07	50	50	35	70
	100	73	52	80
	300	95	87	98
	600	98	98	97

Spray composition	Glufosinate rate g a.i./ha	% Inhibition		
		ABUTH	ECHCF	SIDSP
90-08	50	48	30	88
	100	83	50	93
	300	98	97	96
	600	98	99	96
90-09	50	58	35	92
	100	91	62	93
	300	98	96	97
	600	98	99	96
90-10	50	30	30	0
	100	43	35	10
	300	96	43	92
	600	95	70	91
90-11	50	33	35	0
	100	53	35	7
	300	96	43	89
	600	97	88	93
90-12	50	37	5	5
	100	37	20	10
	300	95	40	88
	600	97	85	93

Results of this test using glufosinate as the exogenous chemical are summarized as follows:

At the low concentration of 0.05% used here, soybean lecithin containing 45% phospholipid (90-03) was a much more effective excipient than the lecithin-based adjuvant LI-700 (90-06) widely used in the art.

Butyl stearate alone at 0.05% (90-05) enhanced effectiveness on ECHCF.

The combination of lecithin and butyl stearate (90-02) gave greater enhancement of effectiveness than either of these two excipient substances alone.

Fluorad FC-754, either alone (90-04) or in combination with lecithin (90-01) gave extremely high effectiveness, similar to that obtained with the commercial standard.

Oleth-20 at the low concentration of 0.05% (90-09) gave extremely high effectiveness, superior on SIDSP to that obtained with the commercial standard. Addition of 0.005% butyl stearate (90-07) or 0.01% methyl oleate (90-08) did not provide further enhancement.

EXAMPLE 91

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 91a. Concentrate compositions 91-01 to 91-12 are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix). Concentrate compositions 91-13 to 91-18 contained colloidal particulates but no surfactant.

The colloidal particulates of this example were in general too large to confer good storage stability to the compositions tested.

Table 91a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant	Type of silica
		Surfactant	Silica		
91-01	488	3.0	0.8	steareth-20	Sident 9
91-02	488	3.0	0.8	steareth-20	Sipernat 22
91-03	488	3.0	0.8	steareth-20	Sipernat 22S
91-04	488	3.0	0.8	oleth-20	Sident 9
91-05	488	3.0	0.8	oleth-20	Sipernat 22
91-06	488	3.0	0.8	oleth-20	Sipernat 22S
91-07	488	3.0	1.5	steareth-20	Sident 9
91-08	488	3.0	1.5	steareth-20	Sipernat 22
91-09	488	3.0	1.5	steareth-20	Sipernat 22S
91-10	488	3.0	1.5	oleth-20	Sident 9
91-11	488	3.0	1.5	oleth-20	Sipernat 22
91-12	488	3.0	1.5	oleth-20	Sipernat 22S
91-13	488		0.8	none	Sident 9
91-14	488		1.5	none	Sipernat 22
91-15	488		0.8	none	Sipernat 22S
91-16	488		1.5	none	Sident 9
91-17	488		0.8	none	Sipernat 22
91-18	488		1.5	none	Sipernat 22S

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 21 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 14 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 91b.

Table 91b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	3	37
	200	10	57
	300	43	87
	400	57	88
Formulation J	100	33	80
	200	72	98
	300	96	99
	400	97	99
91-01	100	47	89
	200	78	97
	300	87	99
	400	98	99
91-02	100	37	83
	200	70	99
	300	90	99
	400	95	100

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
91-03	100	40	89
	200	70	99
	300	90	100
	400	95	100
91-04	100	37	94
	200	58	98
	300	87	99
	400	95	100
91-05	100	30	60
	200	73	95
	300	85	99
	400	97	99
91-06	100	33	67
	200	70	97
	300	78	99
	400	92	100
91-07	100	32	81
	200	60	99
	300	83	98
	400	88	100
91-08	100	40	63
	200	65	93
	300	90	99
	400	90	100
91-09	100	43	70
	200	55	98
	300	88	99
	400	94	100
91-10	100	33	91
	200	70	99
	300	83	99
	400	94	99
91-11	100	20	63
	200	70	97
	300	92	100
	400	94	100
91-12	100	48	67
	200	70	93
	300	88	98
	400	94	100
91-13	100	20	50
	200	60	83
	300	83	97
	400	94	99
91-14	100	43	43
	200	67	88
	300	83	97
	400	91	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
91-15	100	30	50
	200	67	73
	300	77	96
	400	97	96
91-16	100	43	43
	200	75	79
	300	87	94
	400	87	91
91-17	100	40	27
	200	68	53
	300	87	92
	400	93	98
91-18	100	47	10
	200	75	37
	300	83	63
	400	92	88

Many of the high-load (488 g a.e./l) glyphosate formulations of this Example exhibited herbicidal effectiveness equal to or greater than that obtained with commercial standard Formulation J, in spite of containing only 3% alkylether surfactant.

EXAMPLE 92

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 92a. Concentrate compositions 92-01 to 92-12 and 92-14 to 92-16 are oil-in-water emulsions and were prepared by process (vii). Concentrate composition 92-13 is an aqueous solution concentrate and was prepared by process (viii).

Table 92a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of oil	Type of surfactant
		Oil	Surfactant		
92-01	163	0.5	5.0	butyl stearate	steareth-30
92-02	163	0.5	5.0	methyl stearate	steareth-30
92-03	163	0.5	5.0	butyl stearate	Neodol 45-13
92-04	163	0.5	5.0	methyl stearate	Neodol 45-13
92-05	163	0.5	5.0	butyl stearate	ceteareth-15
92-06	163	0.5	5.0	methyl stearate	ceteareth-15
92-07	163	0.5	5.0	butyl stearate	laureth-23
92-08	163	0.5	5.0	butyl stearate	oleth-20
92-09	163	0.5	5.0	butyl stearate	steareth-20
92-10	163	0.5	5.0	butyl stearate	ceteareth-27
92-11	163	0.3	5.0	butyl stearate	ceteareth-27
92-12	163	0.3	2.5	butyl stearate	ceteareth-27
92-13	163		5.0	none	ceteareth-27
92-14	163	0.5	5.0	methyl stearate	ceteareth-27
92-15	163	0.5	5.0	methyl stearate	steareth-20
92-16	163	0.5	5.0	methyl stearate	oleth-20

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 20 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 16 days after application.

Formulations B, C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 92b.

Table 92b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	45	57
	200	35	53
	300	50	57
	400	38	33
Formulation C	100	70	98
	200	90	99
	300	97	100
	400	100	100
Formulation J	100	72	88
	200	93	99
	300	97	99
	400	98	99
92-01	100	83	97
	200	97	100
	300	99	100
	400	100	100
92-02	100	80	99
	200	96	100
	300	99	100
	400	99	100
92-03	100	73	98
	200	92	100
	300	98	99
	400	99	100
92-04	100	73	98
	200	87	99
	300	97	99
	400	99	100
92-05	100	80	98
	200	87	100
	300	98	100
	400	100	100
92-06	100	78	97
	200	95	98
	300	98	100
	400	99	100

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
92-07	100	78	98
	200	88	100
	300	96	100
	400	98	100
92-08	100	75	98
	200	93	99
	300	97	99
	400	100	99
92-09	100	83	93
	200	95	100
	300	98	100
	400	100	100
92-10	100	80	97
	200	95	98
	300	98	99
	400	100	100
92-11	100	80	97
	200	93	99
	300	98	100
	400	100	99
92-12	100	77	93
	200	88	100
	300	99	100
	400	99	100
92-13	100	80	73
	200	95	95
	300	99	100
	400	100	100
92-14	100	77	94
	200	92	99
	300	98	100
	400	100	99
92-15	100	78	92
	200	94	99
	300	98	100
	400	99	100
92-16	100	77	93
	200	90	98
	300	98	99
	400	99	100

Extremely high herbicidal effectiveness was provided by ceteareth-27 (composition 92-13); this was further enhanced by addition of a small amount of butyl stearate (92-10, 92-11) or methyl stearate (92-14). Compositions performing better than commercial standard Formulations C and J, at least on ABUTH, included those containing steareth-30, steareth-20 or ceteareth-27; in this test oleth-20 was not quite as effective as these saturated alkylethers.

EXAMPLE 93

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 93a. All are oil-in-water emulsions and were prepared by process (vii). Lecithin (45% phospholipid, Avanti) was first dispersed in water using sonication.

Table 93a

Concentrate composition	Glyphosate g a.e./l	%w/w				
		Lecithin	Butyl stearate	Ethomeen T/25	Ceteareth-20	Ceteareth-27
93-01	220	0.75	0.75	1.5		
93-02	220	0.75	0.75	1.5		
93-03	220	0.75	0.75	3.0		
93-04	220	0.75	7.50	1.5		
93-05	220	0.75	7.50	3.0		
93-06	220	3.75	3.75	3.0		
93-07	220	1.50	1.50	3.0		
93-08	220	1.50	1.50	1.5		
93-09	220	3.75	3.75	1.5	1.5	
93-10	220	1.50	1.50	1.5	1.5	
93-11	220	3.75	7.50	1.5	1.5	
93-12	220	3.75	1.50	1.5	1.5	
93-13	220	0.75	3.75	1.5		1.5
93-14	220	0.75	7.50	1.5		1.5
93-15	220	0.75	3.75	3.0		3.0
93-16	220	0.75	7.50	3.0		3.0
93-17	220		7.50	3.0		
93-18	220	0.75	7.50			3.0

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 23 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 93b.

Table 93b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	12	62
	200	5	55
	300	23	63
	400	43	78
Formulation J	100	27	82
	200	62	98
	300	88	95
	400	96	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
93-01	100	13	79
	200	68	95
	300	82	99
	400	95	91
93-02	100	27	82
	200	60	97
	300	81	95
	400	87	99
93-03	100	37	77
	200	62	96
	300	78	98
	400	89	90
93-04	100	37	84
	200	57	95
	300	84	99
	400	89	100
93-05	100	33	77
	200	65	100
	300	78	97
	400	88	97
93-06	100	43	78
	200	62	95
	300	87	97
	400	95	96
93-07	100	48	78
	200	80	91
	300	90	99
	400	76	93
93-08	100	48	83
	200	67	89
	300	86	96
	400	93	97
93-09	100	62	84
	200	82	98
	300	85	99
	400	91	97
93-10	100	63	80
	200	75	96
	300	85	99
	400	99	99
93-11	100	42	75
	200	78	98
	300	92	99
	400	93	100
93-12	100	52	80
	200	73	93
	300	86	99
	400	97	97

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
93-13	100	55	83
	200	75	97
	300	97	99
	400	92	99
93-14	100	52	87
	200	73	95
	300	91	97
	400	87	98
93-15	100	57	83
	200	92	96
	300	98	100
	400	100	98
93-16	100	79	88
	200	87	97
	300	99	99
	400	97	94
93-17	100	58	83
	200	47	94
	300	88	98
	400	91	93
93-18	100	58	87
	200	75	91
	300	83	99
	400	91	98

Outstanding herbicidal effectiveness was provided by composition 93-18, containing lecithin, ceteareth-27 and butyl stearate. Addition of 3% Ethomeen T/25 (93-16) further enhanced effectiveness. Slightly reduced effectiveness at the lowest glyphosate rate was observed on ABUTH when the butyl stearate concentration was cut in half (93-15).

EXAMPLE 94

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 94a. Concentrate compositions 94-01 to 94-04, 94-06, 94-08, 94-10 and 94-18 are oil-in-water emulsions and were prepared by process (vii). Concentrate compositions 94-05, 94-07 and 94-09 are aqueous solution concentrates and were prepared by process (viii). Concentrate compositions 94-11 to 94-17 contain colloidal particulates and were prepared by process (ix).

The compositions of this example all showed acceptable storage stability. The compositions shown as containing colloidal particulate were not storage-stable unless the colloidal particulate was included as shown.

Table 94a

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of surfactant
		Butyl stearate	Surfactant	Aerosil 380	
94-01	163	0.5	5.0		steareth-20
94-02	163	0.5	5.0		ceteareth-27
94-03	163	0.5	5.0		oleth-20
94-04	163	0.5	5.0		ceteth-20
94-05	163		5.0		ceteth-20
94-06	163	0.5	5.0		Neodol 45-13
94-07	163		5.0		Neodol 45-13
94-08	163	0.5	5.0		ceteareth-15
94-09	163		5.0		ceteareth-15
94-10	163	0.5	5.0		steareth-30
94-11	360	1.0	10.0	1.25	ceteth-20
94-12	360	1.0	10.0	1.25	Neodol 45-13
94-13	360	1.0	10.0	1.25	ceteareth-15
94-14	360	1.0	10.0	1.25	steareth-30
94-15	360	1.0	10.0	1.25	steareth-20
94-16	360	1.0	10.0	1.25	oleth-20
94-17	360	1.0	10.0	1.25	ceteareth-27
94-18	163	0.5	5.0		laureth-23

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 22 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 94b.

Table 94b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	0	30
	200	2	60
	300	17	75
	400	50	73
Formulation J	100	20	63
	200	42	98
	300	75	100
	400	83	98
94-01	100	27	57
	200	67	98
	300	80	99
	400	87	98

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
94-02	100	27	63
	200	53	87
	300	77	99
	400	87	99
94-03	100	12	50
	200	53	99
	300	65	100
	400	83	99
94-04	100	20	63
	200	50	98
	300	73	98
	400	87	98
94-05	100	18	70
	200	57	93
	300	80	99
	400	83	99
94-06	100	17	63
	200	35	95
	300	60	100
	400	75	100
94-07	100	3	43
	200	43	95
	300	62	100
	400	68	96
94-08	100	20	43
	200	43	88
	300	75	99
	400	80	97
94-09	100	37	57
	200	55	93
	300	83	100
	400	83	99
94-10	100	37	50
	200	60	96
	300	83	99
	400	88	99
94-11	100	8	37
	200	37	93
	300	68	99
	400	70	97
94-12	100	13	43
	200	40	91
	300	67	100
	400	77	96
94-13	100	25	40
	200	40	80
	300	62	97
	400	78	98

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
94-14	100	23	33
	200	37	86
	300	75	99
	400	78	94
94-15	100	23	30
	200	43	78
	300	53	93
	400	78	98
94-16	100	23	37
	200	37	95
	300	63	97
	400	78	95
94-18	100	18	50
	200	45	88
	300	75	69
	400	73	93
94-19	100	missing	missing
	200	missing	missing
	300	missing	missing
	400	missing	missing

Compositions exhibiting herbicidal effectiveness greater than that provided by commercial standard Formulation J included 94-01 (steareth-20 plus butyl stearate), 94-09 (ceteareth-15) and 94-10 (steareth-20 plus butyl stearate).

EXAMPLE 95

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 95a. All are oil-in-water emulsions and were prepared by process (vii).

Table 95a

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
95-01	163	1.00	10.0	laureth-23
95-02	163	0.50	5.0	laureth-23
95-03	163	0.25	2.5	laureth-23
95-04	163	1.00	10.0	Neodol 1-9
95-05	163	0.50	5.0	Neodol 1-9
95-06	163	0.25	2.5	Neodol 1-9
95-07	163	1.00	10.0	steareth-10
95-08	163	0.50	5.0	steareth-10
95-09	163	0.25	2.5	steareth-10
95-10	163	0.50	5.0	steareth-20
95-11	163	0.25	2.5	steareth-20
95-12	163	0.25	1.0	steareth-20
95-13	163	0.50	5.0	oleth-20
95-14	163	0.25	2.5	oleth-20

Concentrate composition	Glyphosate g a.e./l	% w/w		Type of surfactant
		Butyl stearate	Surfactant	
95-15	163	0.25	1.0	oleth-20
95-16	163	0.50	5.0	ceteareth-27
95-17	163	0.25	2.5	ceteareth-27
95-18	163	0.25	1.0	ceteareth-27

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 21 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 20 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 95b.

Table 95b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	0	42
	200	0	43
	300	23	50
	400	0	28
Formulation J	100	0	73
	200	57	85
	300	68	93
	400	87	94
95-01	100	18	75
	200	58	92
	300	85	90
	400	94	95
95-02	100	3	77
	200	47	90
	300	65	89
	400	87	95
95-03	100	13	80
	200	53	88
	300	72	98
	400	82	99
95-04	100	0	0
	200	53	88
	300	67	95
	400	83	95
95-05	100	2	60
	200	50	83
	300	70	93
	400	85	92

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
95-06	100	0	52
	200	55	83
	300	62	96
	400	77	98
95-07	100	8	70
	200	68	95
	300	91	99
	400	95	100
95-08	100	10	65
	200	67	99
	300	78	99
	400	93	100
95-09	100	5	80
	200	52	98
	300	75	100
	400	86	98
95-10	100	0	65
	200	62	84
	300	58	94
	400	75	100
95-11	100	5	83
	200	50	99
	300	63	97
	400	87	99
95-12	100	10	76
	200	60	96
	300	72	100
	400	100	100
95-13	100	20	85
	200	67	100
	300	91	100
	400	96	98
95-14	100	23	68
	200	62	89
	300	80	100
	400	99	99
95-15	100	5	57
	200	55	93
	300	89	95
	400	90	98
95-16	100	30	68
	200	68	94
	300	83	98
	400	100	100
95-17	100	43	68
	200	62	99
	300	78	100
	400	100	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
95-18	100	25	52
	200	53	84
	300	85	94
	400	98	95

Compositions having a 1:3 or lower weight/weight ratio of surfactant to glyphosate a.e., yet outperforming commercial standard Formulation J at least on ABUTH in this test, included those containing just 1% alkylether surfactant (ratio about 1:15) together with 0.25% butyl stearate, where the alkylether surfactant was steareth-20 (95-12), oleth-20 (95-15) or ceteareth-27 (95-18).

EXAMPLE 96

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 96a. All are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix).

The compositions of this example all showed acceptable storage stability. The compositions shown as containing colloidal particulate were not storage-stable unless the colloidal particulate was included as shown.

Table 96a

Conc. comp.	Glyphosate g a.e./l	% w/w			Type of surfactant	Type of Aerosil	Other component
		Surfactant	Aerosil	Other			
96-01	488	3.0	1.5		steareth-20	MOX-80/380 (1:2)	
96-02	488	4.5	1.5		steareth-20	380	
96-03	488	4.5	1.5		steareth-20	MOX-80/380 (1:2)	
96-04	488	4.5	1.5		steareth-20	MOX-80/MOX-170 (1:2)	
96-05	488	6.0	1.5	4.12	steareth-20	380	glycerin
96-06	488	3.0	1.5		steareth-20	380	
96-07	488	3.0	1.5	7.12	oleth-20	380	propylene glycol
96-08	488	3.0	1.5		oleth-20	MOX-80/380 (1:2)	
96-09	488	4.5	1.5		oleth-20	380	
96-10	488	4.5	1.5		oleth-20	MOX-80/380 (1:2)	

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 21 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 20 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 96b.

Table 96b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	0	25
	200	35	27
	300	48	28
	400	47	48
Formulation J	100	50	75
	200	80	90
	300	97	96
	400	99	98
96-01	100	53	33
	200	83	52
	300	98	72
	400	98	79
96-02	100	43	27
	200	80	57
	300	87	73
	400	96	78
96-03	100	48	30
	200	81	70
	300	98	78
	400	63	57
96-04	100	45	32
	200	87	75
	300	97	73
	400	98	83
96-05	100	38	27
	200	37	23
	300	45	32
	400	35	18
96-06	100	42	40
	200	78	52
	300	91	72
	400	96	80
96-07	100	37	43
	200	48	32
	300	73	58
	400	55	28
96-08	100	43	37
	200	68	57
	300	84	62
	400	89	82
96-09	100	37	32
	200	83	67
	300	94	82
	400	63	48

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
96-10	100	32	40
	200	75	68
	300	90	88
	400	65	63

Several high-load (488 g a.e./l) glyphosate compositions exhibited herbicidal effectiveness on ABUTH equal to commercial standard Formulation J, but none was equal to Formulation J on ECHCF in this test.

EXAMPLE 97

Dry granular concentrate compositions were prepared containing glyphosate ammonium salt and excipient ingredients as shown in Table 97a. The preparation procedure was as follows. Ammonium glyphosate powder was added to a blender. Excipient ingredients were slowly added, together with sufficient water to wet the powder and form a stiff dough. The blender was operated for sufficient time to thoroughly mix all ingredients. The dough was then transferred to extrusion apparatus and was extruded to form granules, which were finally dried in a fluid bed dryer.

Table 97a

Conc. comp.	% w/w					Type of surfactant	Type of colloidal particulate
	Glyphosate a.e.	Lecithin	Butyl stearate	Surfactant	Colloidal particulate		
97-01	68.7			21.0		steareth-20	
97-02	66.0		2.2	22.0		steareth-20	
97-03	66.1			24.0		oleth-20	
97-04	66.0		2.2	22.0		oleth-20	
97-05	67.9	10.0	2.0	10.0		MON 0818	
97-06	59.2	10.0		20.0 + 2.0		FC-754 + MON 0818	
97-07	68.0			21.0	0.8	Flomo 1407	Aerosil 90
97-08	68.0			21.0	0.8	Flomo 1407	Aluminum oxide C
97-09	66.1			24.0		ceteth-20	
97-10	66.0		2.2	22.0		ceteth-20	
97-11	71.2			16.1	2.0	ceteth-20	Aerosil 380
97-12	71.1			16.3	1.0	ceteth-20	Aerosil blend (*)
97-13	71.2			16.1	2.0	steareth-20	Aerosil 380
97-14	71.2			16.1	1.0	steareth-20	Aerosil blend (*)
97-15	68.0			20.0	1.9	oleth-20	Aerosil-380
97-16	70.8			16.6	1.0	oleth-20	Aerosil blend (*)

(*) Aerosil MOX-80 + Aerosil MOX-170 (1:1)

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 21 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 20 days after application.

Formulations J and K were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 97b.

Table 97b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation J	100	52	80
	200	90	96
	300	96	100
	400	97	99
Formulation K	100	33	70
	200	67	93
	300	83	99
	400	93	100
97-01	100	47	60
	200	87	98
	300	97	98
	400	100	98
97-02	100	47	63
	200	80	94
	300	90	99
	400	98	100
97-03	100	62	62
	200	83	93
	300	97	96
	400	97	100
97-04	100	47	57
	200	78	94
	300	87	100
	400	98	100
97-05	100	25	53
	200	60	88
	300	80	97
	400	83	98
97-06	100	35	37
	200	65	62
	300	83	83
	400	90	95
97-07	100	63	55
	200	72	97
	300	83	100
	400	94	100
97-08	100	30	65
	200	72	94
	300	87	100
	400	92	99
97-09	100	37	63
	200	77	83
	300	88	99
	400	97	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
97-10	100	40	55
	200	83	93
	300	94	96
	400	98	99
97-11	100	42	55
	200	78	94
	300	88	92
	400	94	99
97-12	100	38	58
	200	78	97
	300	92	97
	400	95	100
97-13	100	25	50
	200	80	88
	300	96	95
	400	98	98
97-14	100	50	53
	200	88	92
	300	98	99
	400	99	99
97-15	100	33	57
	200	75	91
	300	94	97
	400	98	99
97-16	100	33	55
	200	77	90
	300	88	99
	400	96	100

Several dry granular compositions of this Example outperformed commercial standard composition K, at least on ABUTH. They included 97-01 to 97-04 and 97-10 to 97-16, all containing an alkylether surfactant (steareth-20, oleth-20 or ceteth-20).

EXAMPLE 98

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 98a. All are oil-in-water emulsions and were prepared by process (vii). Soybean lecithin (45% phospholipid, Avanti) was first dispersed in water either by ultrasonication or by use of a microfluidizer as indicated in the column of Table 98a headed "Process".

Table 98a

Conc. comp.	Glyphosate g a.e./l	% w/w						Process (*)
		Lecithin	Butyl stearate	Ethomeen T/25	MON 0818	Ceteareth-20	Ceteareth-27	
98-01	220	0.75	3.75	3.0			3.0	B
98-02	220	0.75	0.75	3.0			3.0	B
98-03	220	0.75	3.75	3.0		3.0		B
98-04	220	0.75	0.75	3.0		3.0		B
98-05	220	6.00	1.50	3.0		3.0		B
98-06	220	6.00	1.50	3.0			3.0	B
98-07	220	4.00	1.00	3.0		3.0		B
98-08	220	4.00	1.00	3.0			3.0	B
98-09	220	0.75	3.75	3.0			3.0	A
98-10	220	0.75	0.75	3.0			3.0	A
98-11	220	0.75	3.75	6.0				B
98-12	220	0.75	3.75			6.0		B
98-13	345	6.00	1.50	4.5	4.5			B
98-14	345	6.00	1.50	6.0			3.0	B
98-15	345	6.00	1.50	6.0	6.0			B
98-16	345	0.50	7.50	12.0				B
98-17	345	6.00	1.50	4.5	4.5		3.0	B

(*) Process:

A Ultrasonicated
B Microfluidized, 3 cycles

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 19 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 15 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 98b.

Table 98b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	45	82
	250	55	71
	350	80	72
	450	88	77
Formulation J	150	55	83
	250	89	88
	350	97	93
	450	99	93
	550	99	87

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
98-01	150	92	83
	250	96	96
	350	99	96
	450	100	86
98-02	150	85	93
	250	97	78
	350	97	90
	450	99	90
98-03	150	87	85
	250	98	92
	350	99	95
	450	100	95
98-04	150	87	89
	250	97	92
	350	99	94
	450	99	91
98-05	150	87	77
	250	98	89
	350	99	93
	450	99	84
98-06	150	12	18
	250	96	73
	350	99	85
	450	99	84
98-07	150	82	89
	250	88	96
	350	96	98
	450	97	97
98-08	150	88	94
	250	95	90
	350	99	98
	450	99	98
98-09	150	94	94
	250	95	100
	350	97	99
	450	99	98
98-10	150	94	94
	250	98	99
	350	99	97
	450	99	96
98-11	150	83	81
	250	94	88
	350	98	93
	450	99	99
98-12	150	68	79
	250	95	96
	350	98	100
	450	99	98

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
98-13	150	86	98
	250	95	98
	350	99	100
	450	100	98
98-14	150	85	98
	250	98	98
	350	99	98
	450	100	98
98-15	150	86	95
	250	97	97
	350	99	95
	450	100	96
98-16	150	93	94
	250	98	98
	350	99	98
	450	100	97
98-17	150	95	96
	250	98	100
	350	100	100
	450	100	98

Many compositions containing lecithin and butyl stearate outperformed commercial standard Formulation J in this test.

EXAMPLE 99

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 99a. Concentrate compositions 99-04 and 99-05 are aqueous solution concentrates and were prepared by process (viii). Concentrate compositions 99-06 to 99-13 are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix). Concentrate compositions 99-01 to 99-03 contain colloidal particulate but no surfactant.

The compositions of this example containing colloidal particulate all showed acceptable storage stability. Of those containing steareth-20 but no colloidal particulate, composition 99-04 was acceptable storage-stable but composition 99-05 was not.

Table 99a

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of Aerosil
		Steareth-20	Oleth-20	Aerosil	
99-01	484			1.5	MOX-80
99-02	484			1.5	380
99-03	484			1.5	MOX-80/MOX-170 (1:1)
99-04	484	1.5			none
99-05	484	3.0			none
99-06	484	3.0		1.5	MOX-170
99-07	484	3.0		1.5	380
99-08	484	3.0		1.5	MOX-80/380 (1:1)

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of Aerosil
		Steareth-20	Oleth-20	Aerosil	
99-09	484	3.0		1.5	MOX-80/MOX-170 (1:1)
99-10	484		3.0	1.5	MOX-80
99-11	484		3.0	1.5	MOX-170
99-12	484		3.0	1.5	380
99-13	484		3.0	1.5	MOX-80/380 (1:1)

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 20 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 19 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 99b.

Table 99b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	3	38
	200	28	63
	300	37	75
	400	55	78
Formulation J	100	23	73
	200	43	92
	300	67	96
	400	92	97
99-01	100	23	60
	200	40	77
	300	65	91
	400	75	92
99-02	100	18	50
	200	25	53
	300	33	75
	400	67	82
99-03	100	27	57
	200	35	72
	300	50	86
	400	70	93
99-04	100	42	67
	200	48	78
	300	78	82
	400	80	85
99-05	100	28	43
	200	45	77
	300	70	92
	400	80	95

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
99-06	100	42	57
	200	70	75
	300	89	87
	400	94	94
99-07	100	43	68
	200	62	90
	300	88	92
	400	97	92
99-08	100	53	57
	200	72	87
	300	88	94
	400	92	97
99-09	100	27	60
	200	62	75
	300	75	92
	400	83	90
99-10	100	47	43
	200	73	73
	300	82	88
	400	97	93
99-11	100	48	57
	200	63	75
	300	80	91
	400	89	98
99-12	100	30	40
	200	42	63
	300	68	75
	400	73	83
99-13	100	37	40
	200	57	75
	300	73	80
	400	78	94

Remarkably strong herbicidal effectiveness was provided by composition 99-05, in spite of its very low surfactant (steareth-20) to glyphosate a.e. ratio of about 1:13. Activity, at least on ABUTH, was further improved to a significant degree by inclusion in the composition of colloidal particulates such as Aerosil MOX-170 (99-06), Aerosil 380 (99-07), a blend of Aerosil MOX-80 and Aerosil 380 (99-08), and a blend of Aerosil MOX-80 and Aerosil MOX-170 (99-09).

EXAMPLE 100

Aqueous and dry granular concentrate compositions were prepared as shown in Table 100a. Dry granular concentrate compositions 100-01 to 100-11 contain glyphosate ammonium salt, and were prepared by the process described in Example 97.

Aqueous concentrate compositions 100-12 to 100-16 contain glyphosate IPA salt and were prepared by process (v), using soybean lecithin (45% phospholipid, Avanti).

Table 100a

Conc. comp.	Glyphos-ate g a.e./l	% w/w					Type of surfactant	Type of colloidal particulate
		Glyphos-ate a.e.	Lecithin	Butyl stearate	Surfactant	Colloidal particulate		
100-01		68.7			21.0		steareth-20	
100-02		66.1			24.0		oleth-20	
100-03		67.9	10.0	2.0	10.0		MON 0818	
100-04		59.2	10.0		20.0 + 2.0		FC-754 + MON 0818	
100-05		66.1			24.0		ceteth-20	
100-06		71.2			16.1	2.0	steareth-20	Aerosil 380
100-07		71.2			16.1	2.0	steareth-20	Aerosil blend
100-08		68.0			20.0	1.9	oleth-20	Aerosil 380
100-09		63.5			25.0	2.0	steareth-20	Aerosil blend
100-10		67.9			20.0	2.0	steareth-20	Aerosil blend
100-11		72.2			15.0	2.0	steareth-20	Aerosil blend
100-12	370		4.7		4.7		steareth-20	
100-13	350		4.9		4.9		ceteareth-27	
100-14	348		5.0		5.0		ceteareth-15	
100-15	348		5.0		5.0		oleth-20	
100-16	351		4.4		5.0		steareth-30	

Aerosil blend: Aerosil MOX-80 + Aerosil MOX-170 (1:1)

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 20 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 16 days after application.

Formulations J and K were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 100b.

Table 100b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation J	100	0	20
	200	28	57
	300	58	96
	400	73	99
Formulation K	100	22	13
	200	42	83
	300	48	91
	400	58	95
100-01	100	28	30
	200	48	80
	300	80	97
	400	85	99

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
100-02	100	43	52
	200	68	80
	300	72	88
	400	86	94
100-03	100	23	37
	200	50	83
	300	75	88
	400	85	96
100-04	100	50	45
	200	73	80
	300	85	92
	400	95	94
100-05	100	18	45
	200	65	83
	300	87	95
	400	94	86
100-06	100	47	50
	200	62	68
	300	82	94
	400	91	87
100-07	100	50	47
	200	60	78
	300	87	87
	400	93	93
100-08	100	30	55
	200	55	77
	300	82	85
	400	88	97
100-09	100	45	50
	200	57	78
	300	83	83
	400	84	89
100-10	100	42	50
	200	57	80
	300	73	91
	400	91	90
100-11	100	28	48
	200	50	75
	300	70	87
	400	82	89
100-12	100	20	40
	200	63	80
	300	67	96
	400	80	88
100-13	100	27	35
	200	50	85
	300	77	90
	400	84	86

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
100-14	100	27	25
	200	40	70
	300	68	94
	400	89	91
100-15	100	17	20
	200	47	82
	300	58	89
	400	91	95
100-16	100	22	20
	200	41	80
	300	84	89
	400	99	98

All compositions of the invention in this study exhibited greater herbicidal effectiveness on both ABUTH and ECHCF, in some cases by a very substantial margin, than commercial standard Formulation K.

EXAMPLE 101

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 101a. All contain colloidal particulates and were prepared by process (ix).

The compositions of this example all showed acceptable storage stability. The compositions shown as containing colloidal particulate were not storage-stable unless the colloidal particulate was included as shown.

Table 101a

Conc. comp.	Glyphosate g a.e./l	% w/w			Type of oil	Type of surfactant
		Oil	Surfactant	Aerosil 380		
101-01	360	1.0	10.0	1.25	butyl stearate	oleth-20
101-02	360	1.0	10.0	1.25	stearylamine	oleth-20
101-03	360	1.0	10.0	1.25	stearyl alcohol	oleth-20
101-04	360	1.0	10.0	1.25	docosane	oleth-20
101-05	360		10.0	1.25	none	oleth-20
101-06	360	1.0	10.0	1.25	butyl stearate	steareth-30
101-07	360	1.0	10.0	1.25	stearylamine	steareth-30
101-08	360	1.0	10.0	1.25	stearyl alcohol	steareth-30
101-09	360	1.0	10.0	1.25	docosane	steareth-30
101-10	360		10.0	1.25	none	steareth-30
101-11	360		5.0 + 5.0	1.25	none	oleth-20 + steareth-20
101-12	360		5.0 + 5.0	1.25	none	oleth-20 + steareth-30
101-13	360		5.0 + 5.0	1.25	none	oleth-20 + ceteareth-27
101-14	360		5.0 + 5.0	1.25	none	oleth-20 + ceteareth-15
101-15	360		5.0 + 5.0	1.25	none	steareth-30 + steareth-20
101-16	360		5.0 + 5.0	1.25	none	steareth-30 + ceteareth-27
101-17	360		5.0 + 5.0	1.25	none	steareth-30 + ceteareth-15
101-18	360		10.0	1.25	none	laureth-23

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 19 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 101b.

Table 101b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	0	60
	200	15	73
	300	33	88
	400	57	91
Formulation J	100	5	70
	200	37	92
	300	80	99
	400	77	96
101-01	100	13	88
	200	32	85
	300	48	98
	400	90	93
101-02	100	10	70
	200	45	98
	300	72	99
	400	80	98
101-03	100	3	77
	200	25	94
	300	47	98
	400	75	99
101-04	100	7	67
	200	23	94
	300	40	99
	400	7	47
101-05	100	7	76
	200	25	88
	300	45	96
	400	75	97
101-06	100	12	96
	200	30	97
	300	45	98
	400	15	60
101-07	100	8	83
	200	12	97
	300	35	94
	400	50	98

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
101-08	100	15	72
	200	30	88
	300	40	99
	400	0	33
101-09	100	5	73
	200	15	94
	300	47	99
	400	5	53
101-10	100	7	79
	200	15	95
	300	45	98
	400	62	99
101-11	100	5	84
	200	13	98
	300	30	98
	400	55	100
101-12	100	3	95
	200	17	99
	300	28	99
	400	67	100
101-13	100	5	90
	200	17	99
	300	30	100
	400	60	98
101-14	100	3	98
	200	25	97
	300	38	100
	400	57	100
101-15	100	5	97
	200	25	97
	300	40	100
	400	40	99
101-16	100	10	97
	200	15	98
	300	52	100
	400	0	47
101-17	100	7	97
	200	25	94
	300	40	98
	400	33	97
101-18	100	7	96
	200	25	99
	300	55	100
	400	73	100

Percent inhibition data for the 400 g a.e./ha glyphosate rate in this test are unreliable and should be ignored. Neither oleth-20 (composition 101-05) nor steareth-20 (101-10) provided herbicidal

effectiveness equal to Formulation J in this study, and no great or consistent further enhancement was obtained by adding butyl stearate.

EXAMPLE 102

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 102a. Concentrate compositions 102-01 to 102-03 are oil-in-water emulsions and were prepared by process (vii). Compositions 102-04 to 102-18 all contain colloidal particulates and were prepared by process (ix). Different mixing methods were employed in the final stage of preparation of these compositions, as indicated in the column of Table 102a headed "Process".

The compositions of this example all showed acceptable storage stability. The compositions shown as containing colloidal particulate were not storage-stable unless the colloidal particulate was included as shown.

Table 102a

Concentrate composition	Glyphosate g a.e./l	% w/w			Type of surfactant	Process (*)
		Butyl stearate	Surfactant	Aerosil 380		
102-01	163	0.5	5.0		oleth-20	
102-02	163	0.5	5.0		steareth-20	
102-03	163	0.5	5.0		ceteareth-27	
102-04	360	1.0	10.0	1.25	ceteareth-15	A
102-05	360	1.0	10.0	1.25	ceteth-20	A
102-06	360	1.0	10.0	1.25	steareth-20	A
102-07	360	1.0	10.0	1.25	oleth-20	A
102-08	360	1.0	10.0	1.25	ceteareth-27	A
102-09	360	1.0	10.0	1.25	steareth-30	A
102-10	360		10.0	1.25	steareth-30	A
102-11	360	1.0	10.0	1.25	oleth-20	A
102-12	360	1.0	10.0	1.25	oleth-20	B
102-13	360	1.0	10.0	1.25	oleth-20	C
102-14	360	1.0	10.0	1.25	oleth-20	D
102-15	360	1.0	10.0	1.25	oleth-20	E
102-16	360	1.0	10.0	1.25	oleth-20	F
102-17	360	1.0	10.0	1.25	oleth-20	G
102-18	360	1.0	10.0	1.25	oleth-20	A

(*) Process:

A	Silverson mixer, medium screen, 3 minutes at 7000 rpm
B	Silverson mixer, coarse screen, 3 minutes at 7000 rpm
C	Fann mixer, 50% output, 5 minutes
D	Turrax mixer, 3 minutes at 8000 rpm
E	Overhead stirrer, low speed
F	Overhead stirrer, high speed
G	Hand shaking, 3 minutes

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray

compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 19 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 102b.

Table 102b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition ABUTH	% Inhibition ECHCF
Formulation B	100	20	40
	200	45	50
	300	65	72
	400	78	85
Formulation J	100	43	53
	200	80	80
	300	96	82
	400	99	94
102-01	100	45	57
	200	80	72
	300	89	78
	400	98	83
102-02	100	53	57
	200	80	78
	300	89	77
	400	93	83
102-03	100	45	60
	200	83	75
	300	97	73
	400	97	85
102-04	100	45	45
	200	80	80
	300	83	83
	400	95	95
102-05	100	42	42
	200	77	77
	300	93	93
	400	98	98
102-06	100	30	30
	200	42	42
	300	27	30
	400	3	20
102-07	100	40	40
	200	77	75
	300	90	93
	400	97	86
102-08	100	43	50
	200	80	80
	300	92	93
	400	96	98

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
102-09	100	0	2
	200	82	75
	300	83	96
	400	90	88
102-10	100	57	60
	200	80	70
	300	88	88
	400	95	93
102-11	100	35	47
	200	72	75
	300	80	75
	400	85	77
102-12	100	47	47
	200	72	77
	300	80	90
	400	86	78
102-13	100	55	50
	200	75	83
	300	78	92
	400	91	92
102-14	100	52	50
	200	75	78
	300	83	88
	400	99	92
102-15	100	47	47
	200	70	73
	300	87	87
	400	75	63
102-16	100	43	40
	200	78	75
	300	88	88
	400	87	91
102-17	100	43	43
	200	67	88
	300	80	75
	400	92	83
102-18	100	27	40
	200	63	57
	300	82	73
	400	87	70

Results obtained with composition 102-06 are out of line with other data in this Example and an error in formulation or application is suspected. Some differences in herbicidal effectiveness were evident when a composition containing 360 g a.e./l glyphosate, 1% butyl stearate, 10% oleth-20 and 1.25% Aerosil 380 was processed in different ways (102-11 to 102-17). However, as compositions 102-

07 and 102-11 were identically processed yet differed in effectiveness, no firm conclusions can be drawn from this test.

EXAMPLE 103

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 103a. Concentrate compositions 103-01 to 103-09 are aqueous solution concentrates and were prepared by process (viii). Concentrate compositions 103-10 to 103-18 are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix).

Compositions of this example containing 3% or 6% surfactant were not acceptably storage-stable except in the presence of colloidal particulate as shown.

Table 103a

Composition no.	Glyphosate g a.e./l	% w/w				Type of Aerosil
		Steareth-20	Oleth-20	Velvetex AB-45	Aerosil	
103-01	488	1.0				none
103-02	488	3.0				none
103-03	488	6.0				none
103-04	488		1.0			none
103-05	488		3.0			none
103-06	488		6.0			none
103-07	488			1.0		none
103-08	488			3.0		none
103-09	488			4.6		none
103-10	488	1.0			1.5	MOX-80/MOX-170 (1:1)
103-11	488	3.0			1.5	MOX-80/MOX-170 (1:1)
103-12	488	6.0			1.5	MOX-80/MOX-170 (1:1)
103-13	488		1.0		1.5	MOX-80/MOX-170 (1:1)
103-14	488		3.0		1.5	MOX-80/MOX-170 (1:1)
103-15	488		6.0		1.5	MOX-80/MOX-170 (1:1)
103-16	488			1.0	1.5	MOX-80/MOX-170 (1:1)
103-17	488			3.0	1.5	MOX-80/MOX-170 (1:1)
103-18	488			4.6	1.5	MOX-80/MOX-170 (1:1)

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 18 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 103b.

Table 103b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition ABUTH	% Inhibition ECHCF
Formulation B	100	10	40
	200	38	67
	300	70	80
	400	86	92
Formulation J	100	43	58
	200	65	82
	300	91	94
	400	100	95
103-01	100	23	60
	200	40	65
	300	73	87
	400	80	92
103-02	100	38	67
	200	77	82
	300	95	83
	400	99	93
103-03	100	33	67
	200	78	73
	300	90	94
	400	100	96
103-04	100	23	63
	200	48	81
	300	68	87
	400	72	88
103-05	100	30	63
	200	63	80
	300	78	89
	400	95	93
103-06	100	25	85
	200	68	93
	300	77	93
	400	99	95
103-07	100	13	60
	200	42	80
	300	57	95
	400	92	96
103-08	100	20	73
	200	43	92
	300	83	93
	400	72	96
103-09	100	30	73
	200	50	94
	300	65	96
	400	75	98

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
103-10	100	10	65
	200	53	88
	300	72	94
	400	83	95
103-11	100	15	50
	200	57	77
	300	82	95
	400	92	97
103-12	100	30	70
	200	68	98
	300	78	97
	400	96	98
103-13	100	15	77
	200	43	93
	300	68	95
	400	77	99
103-14	100	10	73
	200	40	93
	300	68	98
	400	78	98
103-15	100	missing	missing
	200	missing	missing
	300	missing	missing
	400	missing	missing
103-16	100	0	60
	200	30	93
	300	40	99
	400	50	99
103-17	100	2	83
	200	43	99
	300	67	100
	400	67	100
103-18	100	5	95
	200	37	100
	300	60	100
	400	78	100

In high-load (488 g a.e./l) glyphosate compositions, steareth-20 at 3% or 6% provided greater herbicidal effectiveness in this test than the same concentrations of oleth-20. Even at just 3%, steareth-20 (composition 103-02) gave effectiveness equal to commercial standard Formulation J. Addition of a blend of colloidal particulates to stabilize the composition (103-11) slightly reduced effectiveness in this study.

EXAMPLE 104

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 104a. Concentrate compositions 104-01 to 104-04 are aqueous solution

concentrates and were prepared by process (viii). Concentrate compositions 104-08 to 104-18 are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix). Concentrate compositions 104-05 to 104-07 contain colloidal particulate but no surfactant.

All compositions of this example except 104-01 to 104-03 were acceptably storage-stable.

Table 104a

Concentrate composition	Glyphosate g a.e./l	% w/w				Type of Aerosil
		Steareth-20	Steareth-100	MON 0818	Aerosil	
104-01	488	3.0				
104-02	488	4.5				
104-03	488	6.0				
104-04	488			3.0		
104-05	488				1.5	380
104-06	488				1.5	MOX-80/MOX-170 (1:1)
104-07	488				3.0	MOX-80/380 (1:1)
104-08	488		1.5			
104-09	488	3.0		3.0	1.5	380
104-10	488	4.5		3.0	1.5	380
104-11	488	6.0		3.0	1.5	380
104-12	488	3.0		3.0	1.5	MOX-80/MOX-170 (1:1)
104-13	488	4.5		3.0	1.5	MOX-80/MOX-170 (1:1)
104-14	488	6.0		3.0	1.5	MOX-80/MOX-170 (1:1)
104-15	488	3.0		3.0	1.5	MOX-80/380 (1:1)
104-16	488	4.5		3.0	1.5	MOX-80/380 (1:1)
104-17	488	6.0		3.0	1.5	MOX-80/380 (1:1)
104-18	488		4.5	3.0	1.5	MOX-80/MOX-170 (1:1)

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 21 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 104b.

Table 104b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	2	23
	200	18	50
	300	42	67
	400	63	80
Formulation J	100	20	47
	200	40	86
	300	83	98
	400	93	98

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition ABUTH	% Inhibition ECHCF
104-01	100	10	75
	200	62	83
	300	80	96
	400	93	99
104-02	100	40	60
	200	77	92
	300	87	97
	400	93	99
104-03	100	23	40
	200	38	63
	300	78	91
	400	97	91
104-04	100	20	38
	200	23	77
	300	43	94
	400	73	94
104-05	100	7	30
	200	25	37
	300	42	60
	400	67	63
104-06	100	7	30
	200	20	53
	300	52	67
	400	83	67
104-07	100	5	35
	200	20	63
	300	57	80
	400	43	85
104-08	100	22	83
	200	47	99
	300	86	98
	400	78	100
104-09	100	12	45
	200	25	77
	300	40	83
	400	37	95
104-10	100	13	53
	200	73	99
	300	85	98
	400	99	99
104-11	100	25	50
	200	60	88
	300	93	99
	400	99	99
104-12	100	25	45
	200	57	88
	300	85	97
	400	100	94

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
104-13	100	30	52
	200	68	87
	300	93	99
	400	100	92
104-14	100	40	45
	200	73	88
	300	81	98
	400	100	99
104-15	100	8	57
	200	33	96
	300	81	99
	400	95	99
104-16	100	10	62
	200	48	83
	300	99	98
	400	100	100
104-17	100	27	58
	200	65	92
	300	75	98
	400	93	99
104-18	100	5	40
	200	33	87
	300	55	98
	400	75	98

Among stabilized high-load (488 g a.e./l) glyphosate compositions providing herbicidal effectiveness superior to commercial standard Formulation J, at least on ABUTH, were 104-10 and 104-11 (respectively 4.5% and 6% steareth-20 + 3% MON 0818 + 1.5% Aerosil 380), 104-13 (4.5% steareth-20 + 3% MON 0818 + 1.5% Aerosil MOX-80/MOX-170 blend) and 104-16 (4.5% steareth-20 + 3% MON 0818 + 1.5% Aerosil MOX-80/380 blend). The relatively poor performance of composition 104-04 and the good performance of composition 104-02 shows that the excellent results obtained with the stabilized compositions listed above are primarily attributable to the steareth-20 component.

EXAMPLE 105

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 105a. Concentrate compositions 105-01 to 105-09 are aqueous solution concentrates and were prepared by process (viii). Concentrate compositions 105-10 to 105-18 are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix).

Compositions of this example containing 3% or 6% surfactant were not acceptably storage-stable except in the presence of colloidal particulate as shown.

Table 105a

Concentrate composition	Glyphosate g a.e./l	% w/w				Type of Aerosil
		Steareth-20	Oleth-20	Velvetex AB-45	Aerosil	
105-01	488	1.5				none
105-02	488	3.0				none
105-03	488	6.0				none
105-04	488		1.5			none
105-05	488		3.0			none
105-06	488		6.0			none
105-07	488			1.5		none
105-08	488			3.0		none
105-09	488			4.5		none
105-10	488	1.5			1.5	MOX-80/380 (1:1)
105-11	488	3.0			1.5	MOX-80/380 (1:1)
105-12	488	6.0			1.5	MOX-80/380 (1:1)
105-13	488		1.5		1.5	MOX-80/380 (1:1)
105-14	488		3.0		1.5	MOX-80/380 (1:1)
105-15	488		6.0		1.5	MOX-80/380 (1:1)
105-16	488			1.5	1.5	MOX-80/380 (1:1)
105-17	488			3.0	1.5	MOX-80/380 (1:1)
105-18	488			4.5	1.5	MOX-80/380 (1:1)

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 15 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 22 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 105b.

Table 105b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	0	10
	200	3	27
	300	13	30
	400	33	40
Formulation J	100	2	53
	200	30	97
	300	70	99
	400	80	99
105-01	100	5	67
	200	30	89
	300	58	98
	400	80	100
105-02	100	20	60
	200	45	90
	300	78	99
	400	80	100

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
105-03	100	20	57
	200	47	93
	300	78	96
	400	83	98
105-04	100	3	57
	200	30	83
	300	63	99
	400	82	98
105-05	100	5	53
	200	27	83
	300	47	98
	400	77	100
105-06	100	5	40
	200	23	70
	300	47	92
	400	77	99
105-07	100	3	53
	200	30	85
	300	60	94
	400	72	97
105-08	100	3	50
	200	22	88
	300	53	97
	400	80	100
105-09	100	0	40
	200	20	83
	300	40	99
	400	67	99
105-10	100	0	40
	200	27	60
	300	47	83
	400	78	94
105-11	100	5	47
	200	25	77
	300	57	96
	400	87	97
105-12	100	15	43
	200	52	88
	300	87	98
	400	87	98
105-13	100	0	40
	200	17	70
	300	35	83
	400	53	88
105-14	100	0	33
	200	18	67
	300	28	90
	400	62	98

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
105-15	100	2	33
	200	25	70
	300	53	85
	400	72	97
105-16	100	0	30
	200	17	50
	300	27	67
	400	72	87
105-17	100	0	0
	200	7	63
	300	32	88
	400	47	90
105-18	100	0	5
	200	12	60
	300	25	83
	400	45	97

Compositions containing steareth-20 generally performed better than counterparts containing oleth-20 in this study, both in the presence and in the absence of colloidal particulates.

EXAMPLE 106

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 106a. All contain colloidal particulates and were prepared by process (ix).

The compositions of this example all showed acceptable storage stability. The compositions shown as containing colloidal particulate were not storage-stable unless the colloidal particulate was included as shown.

Table 106a

Concentrate composition	% w/w				Type of oil	Type of surfactant
	Glyphosate a.e.	Oil	Surfactant	Aerosil 380		
106-01	31	1.0	10.0	1.25	Butyl stearate	steareth-20
106-02	31	1.0	10.0	1.25	Butyl stearate	oleth-20
106-03	31	1.0	10.0	1.25	Butyl stearate	steareth-30
106-04	31		10.0	1.25	none	steareth-30

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Treatments were applied at four different hours of the day. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 22 days after application.

Formulation J was applied as a comparative treatment. Results, averaged for all replicates of each treatment, are shown in Table 106b.

Table 106b

Concentrate composition	Hour when applied	Glyphosate rate g a.e./ha	% Inhibition	
			ABUTH	ECHCF
Formulation J	1000	100	5	33
		200	42	75
		300	67	83
		400	77	93
106-01	1000	100	7	33
		200	40	70
		300	50	82
		400	78	91
106-02	1000	100	18	33
		200	37	73
		300	48	91
		400	80	92
106-03	1000	100	30	33
		200	40	75
		300	82	85
		400	83	80
106-04	1000	100	30	30
		200	43	78
		300	78	92
		400	93	95
Formulation J	1200	100	5	38
		200	35	87
		300	53	96
		400	88	99
106-01	1200	100	10	30
		200	47	91
		300	70	89
		400	78	97
106-02	1200	100	5	37
		200	40	75
		300	48	87
		400	70	94
106-03	1200	100	20	37
		200	50	82
		300	78	98
		400	83	97
106-04	1200	100	33	33
		200	45	93
		300	75	98
		400	95	100
Formulation J	1400	100	15	40
		200	30	90
		300	55	100
		400	80	100

Concentrate composition	Hour when applied	Glyphosate rate g a.e./ha	% Inhibition	
			ABUTH	ECHCF
106-01	1400	100	17	40
		200	45	70
		300	75	97
		400	80	98
106-02	1400	100	17	47
		200	35	83
		300	67	97
		400	63	97
106-03	1400	100	30	40
		200	63	80
		300	77	97
		400	78	100
106-04	1400	100	23	40
		200	45	87
		300	73	100
		400	78	100
Formulation J	1600	100	10	37
		200	32	83
		300	52	97
		400	75	98
106-01	1600	100	27	43
		200	40	89
		300	77	99
		400	95	99
106-02	1600	100	20	53
		200	40	95
		300	53	98
		400	80	98
106-03	1600	100	27	60
		200	60	93
		300	78	97
		400	96	100
106-04	1600	100	15	37
		200	43	83
		300	67	97
		400	78	96

Composition 106-03 illustrates the consistency of high-level performance obtainable with, in this case, steareth-30 at an approximately 1:3 weight/weight ratio to glyphosate a.e., together with a small amount of butyl stearate and Aerosil 380. An average of percent inhibition of ABUTH across all four glyphosate rates shows the following comparison of 106-03 with Formulation J, applied at four different hours of the day:

Hour	Formulation J	Composition 106-03
1000	48	59
1200	45	58
1400	48	62
1600	42	65

EXAMPLE 107

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 107a. Concentrate compositions 107-01 to 107-07 are aqueous solution concentrates and were prepared by process (viii). Concentrate compositions 107-08 to 107-18 are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix).

Compositions 107-01 to 107-06 were not acceptably storage-stable. All other compositions showed acceptable storage stability.

Table 107a

Concentrate composition	Glyphosate g a.e./l	% w/w			
		Steareth-30	Steareth-20	Agrimul PG-2069	Aerosil 380
107-01	488	3.00			
107-02	488	4.50			
107-03	488	6.00			
107-04	488		3.00		
107-05	488		4.50		
107-06	488		6.00		
107-07	488			2.0	
107-08	488	3.00			1.5
107-09	488	4.50			1.5
107-10	488	6.00			1.5
107-11	488		3.00		1.5
107-12	488		4.50		1.5
107-13	488		6.00		1.5
107-14	488	1.50	1.50		1.5
107-15	488	2.25	2.25		1.5
107-16	488	3.00	3.00		1.5
107-17	488	2.25	2.25	2.0	1.5
107-18	488	3.00	3.00	2.0	1.5

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 23 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 107b.

Table 107b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	2	20
	200	22	33
	300	35	67
	400	68	73
Formulation J	100	32	63
	200	78	90
	300	83	93
	400	92	97
107-01	100	38	57
	200	50	63
	300	62	80
	400	75	89
107-02	100	20	57
	200	63	70
	300	75	88
	400	80	96
107-03	100	47	53
	200	72	80
	300	87	96
	400	100	99
107-04	100	33	30
	200	48	60
	300	75	73
	400	90	83
107-05	100	10	30
	200	43	50
	300	68	82
	400	83	92
107-06	100	22	40
	200	43	50
	300	75	83
	400	83	87
107-07	100	10	37
	200	40	63
	300	78	86
	400	95	96
107-08	100	23	43
	200	68	63
	300	92	88
	400	98	93
107-09	100	47	57
	200	78	70
	300	95	92
	400	100	96

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
107-10	100	37	57
	200	85	68
	300	92	85
	400	100	93
107-11	100	28	43
	200	63	73
	300	85	83
	400	95	96
107-12	100	40	53
	200	75	88
	300	90	92
	400	100	97
107-13	100	40	53
	200	75	75
	300	99	92
	400	100	98
107-14	100	30	43
	200	68	72
	300	83	82
	400	96	97
107-15	100	38	47
	200	77	72
	300	94	92
	400	100	96
107-16	100	33	43
	200	75	67
	300	92	88
	400	100	94
107-17	100	25	43
	200	68	82
	300	78	96
	400	99	96
107-18	100	13	37
	200	72	70
	300	87	80
	400	99	85

Several stabilized high-load (488 g a.e./l) glyphosate compositions of this Example provided herbicidal effectiveness equal or superior, at least on ABUTH, to that obtained with commercial standard Formulation J.

EXAMPLE 108

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 108a. Concentrate compositions 108-12 to 108-14 are aqueous solution concentrates and were prepared by process (viii). Concentrate compositions 108-01 to 108-11 and 108-

15 to 108-17 are aqueous solution concentrates containing colloidal particulates and were prepared by process (ix).

Table 108a

Conc. comp.	Glyphosate g a.e./l	% w/w				Type of Aerosil
		Steareth-20	Ethomeen T/25	Propylene glycol	Aerosil	
108-01	488	3.0			0.8	380
108-02	488	6.0			1.5	MOX-80/MOX-170 (1:1)
108-03	488	4.5			1.5	380
108-04	488	4.5	2.25	0.5	1.5	MOX-80/380 (1:2)
108-05	488	4.5		0.5	1.5	MOX-80/380 (1:2)
108-06	488	6.0		0.5	1.5	MOX-80/380 (1:2)
108-07	488	3.0	1.50	0.5	1.5	MOX-80/380 (1:2)
108-08	488	6.0	3.00	0.5	1.5	MOX-80/380 (1:2)
108-09	488	3.0	1.50	0.5	1.5	380
108-10	488	4.5	2.25	0.5	1.5	380
108-11	488	6.0	3.00	0.5	1.5	380
108-12	488		1.50	0.5		none
108-13	488		2.25	0.5		none
108-14	488		3.00	0.5		none
108-15	488		1.50	0.5	1.5	MOX-80/380 (1:2)
108-16	488		2.25	0.5	1.5	MOX-80/380 (1:2)
108-17	488		3.00	0.5	1.5	MOX-80/380 (1:2)

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 20 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 108b.

Table 108b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	100	0	3
	200	10	12
	300	43	22
	400	47	27
Formulation J	100	13	15
	200	25	22
	300	58	53
	400	68	82
108-01	100	30	20
	200	60	53
	300	73	88
	400	87	96

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
108-02	100	40	23
	200	63	55
	300	88	87
	400	93	93
108-03	100	42	20
	200	72	55
	300	82	83
	400	90	88
108-04	100	60	32
	200	70	57
	300	90	88
	400	90	93
108-05	100	47	32
	200	67	57
	300	88	85
	400	94	88
108-06	100	33	37
	200	68	67
	300	82	80
	400	90	88
108-07	100	35	37
	200	67	70
	300	87	85
	400	97	93
108-08	100	32	35
	200	67	77
	300	85	92
	400	97	95
108-09	100	27	33
	200	57	67
	300	88	83
	400	93	95
108-10	100	13	33
	200	62	58
	300	80	80
	400	92	92
108-11	100	13	20
	200	60	57
	300	88	63
	400	93	82
108-12	100	10	27
	200	53	53
	300	70	67
	400	88	85
108-13	100	3	28
	200	50	57
	300	67	70
	400	90	82

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
108-14	100	3	28
	200	55	57
	300	70	83
	400	87	87
108-15	100	10	20
	200	58	43
	300	70	72
	400	83	85
108-16	100	12	22
	200	55	57
	300	73	77
	400	92	90
108-17	100	7	20
	200	53	55
	300	70	75
	400	85	88

Several stabilized high-load (488 g a.e./l) glyphosate compositions of this Example provided herbicidal effectiveness equal or superior, on both ABUTH and ECHCF, to that obtained with commercial standard Formulation J.

EXAMPLE 109

Glyphosate-containing spray compositions were prepared by tank-mixing Formulation B with excipients as shown in Table 109.

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 22 days after application. Results, averaged for all replicates of each treatment, are shown in Table 109.

Table 109

Glyphosate composition	Glyphosate rate g a.e./ha	Additive	Ratio add./a.e.	% Inhibition	
				ABUTH	ECHCF
Formulation B	150	none		18	25
	250			73	58
	350			80	82
Formulation J	150	none		47	90
	250			77	93
	350			95	94
Formulation B	150	steareth-10	1:0.3	53	88
	250			83	94
	350			98	98
Formulation B	150	steareth-10	1:1	48	73
	250			67	97
	350			93	99

Glyphosate composition	Glyphosate rate g a.e./ha	Additive	Ratio add./a.e.	% Inhibition	
				ABUTH	ECHCF
Formulation B	150	steareth-10	1:1.5	52	60
	250			65	95
	350			86	99
Formulation B	150	steareth-10	1:3	48	73
	250			65	83
	350			80	98
Formulation B	150	steareth-10	1:6	50	81
	250			60	87
	350			85	97
Formulation B	150	steareth-20	1:0.3	76	92
	250			100	93
	350			100	99
Formulation B	150	steareth-20	1:1	65	75
	250			94	96
	350			99	99
Formulation B	150	steareth-20	1:1.5	52	95
	250			84	92
	350			98	98
Formulation B	150	steareth-20	1:3	53	82
	250			82	100
	350			98	93
Formulation B	150	steareth-20	1:6	47	62
	250			68	93
	350			92	97
Formulation B	150	steareth-30	1:0.3	63	88
	250			97	100
	350			100	100
Formulation B	150	steareth-30	1:1	53	72
	250			88	96
	350			97	97
Formulation B	150	steareth-30	1:1.5	50	79
	250			81	89
	350			96	100
Formulation B	150	steareth-30	1:3	50	67
	250			78	88
	350			97	91
Formulation B	150	steareth-30	1:6	47	58
	250			75	99
	350			89	99
Formulation B	150	ceteareth-30	1:0.3	55	86
	250			89	91
	350			99	100
Formulation B	150	ceteareth-30	1:1	50	86
	250			85	95
	350			97	100
Formulation B	150	ceteareth-30	1:1.5	43	75
	250			80	100
	350			88	98

Glyphosate composition	Glyphosate rate g a.e./ha	Additive	Ratio add./a.e.	% Inhibition	
				ABUTH	ECHCF
Formulation B	150	ceteareth-30	1:3	33	73
	250			60	92
	350			94	100
Formulation B	150	ceteareth-30	1:6	37	73
	250			53	89
	350			88	100
Formulation B	150	Ethomeen T/25	1:0.3	67	90
	250			92	99
	350			100	100
Formulation B	150	Ethomeen T/25	1:1	58	94
	250			83	96
	350			93	98
Formulation B	150	Ethomeen T/25	1:1.5	50	73
	250			86	100
	350			99	100
Formulation B	150	Ethomeen T/25	1:3	45	83
	250			89	95
	350			100	100
Formulation B	150	Ethomeen T/25	1:6	35	82
	250			73	98
	350			88	98

Steareth-20, steareth-30 and ceteareth-30 were more effective additives for Formulation B than steareth-10 in this study.

EXAMPLE 110

Aqueous spray compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 110a. Process (iii) was followed for spray compositions 110-01 to 110-22 and 110-26 to 110-72, using soybean lecithin (45% phospholipid, Avanti). Process (i) was followed for spray compositions 110-23 to 110-25.

Table 110a

Spray compositions	% w/w		
	Lecithin	Butyl stearate	MON 0818
110-01	0.10	0.10	
110-02	0.10	0.08	
110-03	0.10	0.05	
110-04	0.10	0.03	
110-05	0.10	0.01	
110-06	0.08	0.10	
110-07	0.05	0.10	
110-08	0.03	0.10	
110-09	0.01	0.10	
110-10	0.08	0.01	
110-11	0.05	0.01	

Spray compositions	% w/w		
	Lecithin	Butyl stearate	MON 0818
110-12	0.03	0.01	
110-13	0.01	0.01	
110-14	0.01	0.03	
110-15	0.01	0.05	
110-16	0.01	0.08	
110-17	0.03	0.03	
110-18	0.05	0.05	
110-19	0.08	0.08	
110-20	0.08	0.03	
110-21	0.03	0.08	
110-22	0.05		
110-23		0.05	
110-24			0.09
110-25			0.03
110-26	0.09	0.02	0.09
110-27	0.09	0.02	0.05
110-28	0.01	0.01	0.01
110-29	0.01	0.01	0.03
110-30	0.01	0.01	0.05
110-31	0.01	0.01	0.08
110-32	0.01	0.01	0.10
110-33	0.01	0.05	0.01
110-34	0.01	0.05	0.03
110-35	0.01	0.05	0.05
110-36	0.01	0.05	0.08
110-37	0.01	0.05	0.10
110-38	0.01	0.10	0.01
110-39	0.01	0.10	0.03
110-40	0.01	0.10	0.05
110-41	0.01	0.10	0.08
110-42	0.01	0.10	0.10
110-43	0.05	0.01	0.01
110-44	0.05	0.01	0.03
110-45	0.05	0.01	0.05
110-46	0.05	0.01	0.08
110-47	0.05	0.01	0.10
110-48	0.05	0.05	0.01
110-49	0.05	0.05	0.03
110-50	0.05	0.05	0.05
110-51	0.05	0.05	0.08
110-52	0.05	0.05	0.10
110-53	0.05	0.10	0.01
110-54	0.05	0.10	0.03
110-55	0.05	0.10	0.05
110-56	0.05	0.10	0.08
110-57	0.05	0.10	0.10
110-58	0.10	0.01	0.01
110-59	0.10	0.01	0.03

Spray compositions	% w/w		
	Lecithin	Butyl stearate	MON 0818
110-60	0.10	0.01	0.05
110-61	0.10	0.01	0.08
110-62	0.10	0.01	0.10
110-63	0.10	0.05	0.01
110-64	0.10	0.05	0.03
110-65	0.10	0.05	0.05
110-66	0.10	0.05	0.08
110-67	0.10	0.05	0.10
110-68	0.10	0.10	0.01
110-69	0.10	0.10	0.03
110-70	0.10	0.10	0.05
110-71	0.10	0.10	0.08
110-72	0.10	0.10	0.10

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 15 days after application.

Formulations C and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 110b.

Table 110b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation C	280	71	73
Formulation J	280	65	77
110-01	280	60	49
110-02	280	46	47
110-03	280	34	48
110-04	280	33	35
110-05	280	50	33
110-06	280	49	52
110-07	280	39	42
110-08	280	48	38
110-09	280	51	42
110-10	280	37	30
110-11	280	48	30
110-12	280	56	34
110-13	280	41	45
110-14	280	52	56
110-15	280	38	40
110-16	280	53	33
110-17	280	45	40
110-18	280	52	38
110-19	280	37	34

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
110-20	280	36	28
110-21	280	40	38
110-22	280	44	47
110-23	280	60	42
110-24	280	92	76
110-25	280	87	69
110-26	280	89	88
110-27	280	79	80
110-28	280	74	73
110-29	280	91	76
110-30	280	94	92
110-31	280	87	81
110-32	280	93	77
110-33	280	88	73
110-34	280	92	85
110-35	280	90	82
110-36	280	92	77
110-37	280	87	77
110-38	280	88	77
110-39	280	84	74
110-40	280	87	68
110-41	280	93	76
110-42	280	94	78
110-43	280	80	59
110-44	280	69	54
110-45	280	88	74
110-46	280	94	79
110-47	280	95	79
110-48	280	71	63
110-49	280	81	72
110-50	280	81	79
110-51	280	79	85
110-52	280	98	69
110-53	280	69	70
110-54	280	74	69
110-55	280	84	78
110-56	280	86	68
110-57	280	98	82
110-58	280	71	69
110-59	280	95	79
110-60	280	92	70
110-61	280	93	70
110-62	280	98	80
110-63	280	81	74
110-64	280	84	73
110-65	280	89	70
110-66	280	91	65
110-67	280	94	81
110-68	280	87	81

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
110-69	280	72	79
110-70	280	87	76
110-71	280	94	71
110-72	280	97	73

Compositions outperforming commercial standard Formulations C and J on both ABUTH and ECHCF in this test included 110-26, 110-27, 110-30, 110-34, 110-35, 110-51 and 110-57, all containing lecithin, butyl stearate and MON 0818.

EXAMPLE 111

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 111a. Concentrate compositions 111-01 to 111-06 were prepared by process (x), using soybean lecithin (45% phospholipid, Avanti). Composition 111-07 was prepared by process (viii).

Table 111a

Concentrate composition	Glyphosate g a.e./l	% w/w		
		Lecithin	Butyl stearate	Ethomeen T/25
111-01	200	6.0	2	6.0
111-02	200		3	6.0
111-03	200		1.5	9.0
111-04	200		3	9.0
111-05	200	6.0	1.5	9.0
111-06	200	6.0	1.5	3.0
111-07	200			9.0

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 16 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 15 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 111b.

Table 111b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	29	22
	250	41	29
	350	53	32
	450	68	35

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation J	150	43	32
	250	76	43
	350	86	47
	450	94	66
111-01	150	67	33
	250	85	40
	350	96	71
	450	97	59
111-02	150	65	36
	250	81	52
	350	97	68
	450	98	62
111-03	150	67	40
	250	85	77
	350	94	77
	450	97	63
111-04	150	69	38
	250	86	58
	350	93	84
	450	98	62
111-05	150	73	40
	250	83	53
	350	93	75
	450	96	61
111-06	150	45	30
	250	71	38
	350	91	45
	450	89	39
111-07	150	59	39
	250	83	44
	350	95	63
	450	95	70

Data for the 450 g a.e./ha glyphosate rate in this study are unreliable. Application error is suspected. The high levels of Ethomeen T/25 included in compositions of this Example tends to obscure the effects of lecithin and butyl stearate, but composition 111-05, for example, showed outstanding effectiveness.

EXAMPLE 112

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 112a. Process (vii) was followed for concentrate composition 112-08 and process (x) for concentrate compositions 112-01 to 112-07 and 112-09, using soybean lecithin (45% phospholipid, Avanti).

Table 112a

Concentrate composition	Glyphosate g a.e./l	% w/w		
		Lecithin	Butyl stearate	MON 0818
112-01	220	4.0		6.0
112-02	220	4.0	0.5	6.0
112-03	220	4.0	1.0	6.0
112-04	220	4.0	2.0	6.0
112-05	220	2.0	0.5	2.0
112-06	220	2.0	0.5	4.0
112-07	220	2.0	0.5	6.0
112-08	220		0.5	6.0
112-09	220	6.0	1.5	6.0

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 17 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B and C were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 112b.

Table 112b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	40	59
	250	68	61
	350	90	91
	450	93	94
Formulation C	150	74	78
	250	93	90
	350	97	96
	450	100	94
112-01	150	79	85
	250	93	98
	350	96	97
	450	97	95
112-02	150	71	87
	250	93	96
	350	96	94
	450	98	94
112-03	150	87	99
	250	94	100
	350	99	97
	450	97	94

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
112-04	150	89	100
	250	94	99
	350	97	98
	450	98	95
112-05	150	73	100
	250	90	100
	350	95	98
	450	96	94
112-06	150	80	99
	250	94	96
	350	95	100
	450	99	98
112-07	150	88	83
	250	94	92
	350	96	92
	450	100	90
112-08	150	81	91
	250	92	96
	350	97	89
	450	99	92
112-09	150	90	96
	250	93	93
	350	95	95
	450	94	98

Herbicidal effectiveness overall was very high under the conditions of this study but a tendency can be discerned in compositions 112-01 to 112-04 for performance to improve as butyl stearate concentration was increased from zero to 2%.

EXAMPLE 113

Aqueous spray compositions were prepared containing various tetraalkylammonium salts of glyphosate and excipient ingredients as shown in Table 113a. Process (iii) was followed for spray compositions 113-02 to 113-04, 113-06 to 113-08, 113-10 to 113-12 and 113-14 to 113-16, using soybean lecithin (45% phospholipid, Avanti). Compositions 113-01, 113-05, 113-09 and 113-13 are simple solutions of the tetraalkylammonium salts of glyphosate in water.

Table 113a

Spray composition	% w/w Lecithin	Glyphosate salt
113-01		(Me)4N
113-02	0.10	(Me)4N
113-03	0.05	(Me)4N
113-04	0.02	(Me)4N
113-05		(Et)4N
113-06	0.10	(Et)4N
113-07	0.05	(Et)4N

Spray composition	% w/w Lecithin	Glyphosate salt
113-08	0.02	(Et)4N
113-09		(Pr)4N
113-10	0.10	(Pr)4N
113-11	0.05	(Pr)4N
113-12	0.02	(Pr)4N
113-13		(Bu)4N
113-14	0.10	(Bu)4N
113-15	0.05	(Bu)4N
113-16	0.02	(Bu)4N

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray compositions were made 18 days after planting ABUTH and 20 days after planting ECHCF, and evaluation of herbicidal inhibition was done 16 days after application.

Formulations B, C and J were applied as comparative treatments. In addition, Formulations B and C were tank-mixed with a pre-dispersed lecithin composition prepared from soybean lecithin (45% phospholipid, Avanti). Results, averaged for all replicates of each treatment, are shown in Table 113b.

Table 113b

Spray composition	Glyphosate rate g a.e./ha	% Inhibition ABUTH	% Inhibition ECHCF
Formulation B	200	23	34
	400	43	38
	600	69	54
	800	75	41
Formulation B + lecithin 0.1% w/v	200	7	15
	400	31	36
	600	58	37
Formulation B + lecithin 0.05% w/v	200	10	17
	400	34	40
	600	61	47
Formulation B + lecithin 0.025% w/v	200	11	17
	400	27	39
	600	63	39
Formulation C	200	38	62
	400	90	91
	600	96	100
	800	100	99
Formulation C + lecithin 0.1% w/v	200	36	55
	400	81	93
	600	100	95
Formulation C + lecithin 0.05% w/v	200	35	53
	400	79	90
	600	91	99

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation C + lecithin 0.025% w/v	200	32	55
	400	77	88
	600	96	100
Formulation J	200	40	34
	400	83	78
	600	87	96
	800	100	95
113-01	200	27	34
	400	74	52
	600	84	46
113-02	200	39	37
	400	73	64
	600	89	68
113-03	200	24	35
	400	73	59
	600	88	75
113-04	200	29	43
	400	71	59
	600	82	90
113-05	200	51	43
	400	79	48
	600	98	49
113-06	200	58	47
	400	84	81
	600	86	97
113-07	200	69	41
	400	83	84
	600	90	94
113-08	200	55	48
	400	79	79
	600	93	92
113-09	200	73	60
	400	96	58
	600	98	73
113-10	200	69	75
	400	94	94
	600	99	91
113-11	200	72	62
	400	94	98
	600	100	99
113-12	200	76	65
	400	97	79
	600	100	100
113-13	200	85	64
	400	97	58
	600	99	65

Spray composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
113-14	200	83	87
	400	99	84
	600	99	98
113-15	200	87	66
	400	94	96
	600	100	100
113-16	200	91	87
	400	97	91
	600	100	94

Addition of lecithin to composition B (glyphosate IPA salt) did not provide significant enhancement of herbicidal effectiveness. However, when lecithin was added to tetraalkylammonium salts of glyphosate, significant improvements were obtained. In some cases adding a very low amount of lecithin (0.02%) gave better results than adding a larger amount (0.1%). Outstanding effectiveness, for example, was obtained with composition 113-16, containing the tetrabutylammonium salt of glyphosate and 0.02% lecithin.

EXAMPLE 114

Aqueous concentrate compositions were prepared containing glyphosate IPA salt and excipient ingredients as shown in Table 114a. Process (v) was followed for all concentrate compositions, using soybean lecithin (45% phospholipid, Avanti).

Table 114a

Concentrate composition	Glyphosate g a.e./l	% w/w	
		Lecithin	Benzalkonium Cl
114-01	363	8.1	5.4
114-02	363	8.1	4.1
114-03	363	8.1	3.0
114-04	363	8.1	2.1
114-05	372	8.3	2.5
114-06	363	6.8	4.0
114-07	362	6.8	2.9
114-08	355	3.5	10.0
114-09	354	3.0	13.3
114-10	352	2.5	16.7
114-11	352	2.0	20.0
114-12	295	5.0	10.0
114-13	295	4.5	13.3
114-14	294	4.0	16.7
114-15	294	3.5	20.0
114-16	292	3.0	23.3

Velvetleaf (Abutilon theophrasti, ABUTH) and Japanese millet (Echinochloa crus-galli, ECHCF) plants were grown and treated by the standard procedures given above. Applications of spray

compositions were made 18 days after planting ABUTH and ECHCF, and evaluation of herbicidal inhibition was done 18 days after application.

Formulations B and J were applied as comparative treatments. Results, averaged for all replicates of each treatment, are shown in Table 114b.

Table 114b

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
Formulation B	150	52	27
	250	72	40
	350	87	60
	450	88	77
Formulation J	150	82	90
	250	92	99
	350	99	99
	450	100	100
114-01	150	78	97
	250	87	99
	350	98	99
	450	99	100
114-02	150	68	83
	250	73	99
	350	96	99
	450	98	99
114-03	150	65	53
	250	77	92
	350	93	99
	450	98	100
114-04	150	62	76
	250	83	88
	350	96	98
	450	95	99
114-05	150	68	57
	250	90	88
	350	95	98
	450	98	99
114-06	150	72	57
	250	83	98
	350	93	98
	450	98	100
114-07	150	77	69
	250	85	85
	350	97	98
	450	98	99
114-08	150	80	85
	250	93	99
	350	99	100
	450	100	100

Concentrate composition	Glyphosate rate g a.e./ha	% Inhibition	
		ABUTH	ECHCF
114-09	150	88	88
	250	95	99
	350	100	99
	450	100	100
114-10	150	99	97
	250	97	100
	350	100	100
	450	99	99
114-11	150	98	92
	250	98	97
	350	99	99
	450	100	100
114-12	150	83	92
	250	95	99
	350	98	99
	450	99	99
114-13	150	91	95
	250	94	97
	350	99	100
	450	99	100
114-14	150	93	96
	250	90	97
	350	98	99
	450	99	98
114-15	150	90	97
	250	99	97
	350	100	100
	450	99	99
114-16	150	92	94
	250	98	100
	350	99	100
	450	100	99

Overall herbicidal effectiveness in this study was extremely high and enhancements over commercial standard Formulation J are therefore difficult to discern. However, particularly outstanding performance was obtained with compositions 114-10, 114-11 and 114-13 to 114-16 containing lecithin and benzalkonium chloride.

The preceding description of specific embodiments of the present invention is not intended to be a complete list of every possible embodiment of the invention. Persons skilled in this field will recognize that modifications can be made to the specific embodiments described here that would be within the scope of the present invention.

WHAT IS CLAIMED IS:

1. A method of applying an exogenous chemical to a plant, comprising the steps of
   (a) contacting foliage of the plant with a biologically effective amount of the exogenous chemical, and
   (b) contacting the same foliage with an aqueous composition that comprises a first excipient substance that is amphiphilic,

   wherein the weight/weight ratio of said first excipient substance to the exogenous chemical is between about 1:3 and about 1:100; wherein said aqueous composition forms anisotropic aggregates in or on a wax layer; and wherein step (b) occurs simultaneously with or within about 96 hours before or after step (a).

2. The method of claim 1, wherein said first excipient substance is a liposome-forming material that comprises an amphiphilic compound or mixture of such compounds having two hydrophobic moieties, each of which is a saturated alkyl or acyl chain having from about 8 to about 22 carbon atoms; wherein said amphiphilic compound or mixture of such compounds having said two hydrophobic moieties constitutes from about 40 to 100 percent by weight of all amphiphilic compounds having two hydrophobic moieties present in said liposome-forming material.

3. The method of claim 2, wherein the liposome-forming material has a hydrophilic head group comprising a cationic group.

4. The method of claim 3, wherein the cationic group is an amine or ammonium group.

5. The method of claim 1, wherein the first excipient substance comprises a liposome-forming compound having a hydrophobic moiety comprising two saturated or unsaturated hydrocarbyl groups R^1 and R^2 each having about 7 to about 21 carbon atoms, said liposome-forming compound having, at a pH of 4, a formula selected from the group consisting of:

   (a) $N^+(CH_2R^1)(CH_2R^2)(R^3)(R^4)\ Z^-$

   wherein R^3 and R^4 are independently hydrogen, C_{1-4} alkyl or C_{1-4} hydroxyalkyl and Z is a suitable anion;

   (b) $N^+(R^5)(R^6)(R^7)CH_2CH(OCH_2R^1)CH_2(OCH_2R^2)\ Z^-$

   wherein R^5, R^6 and R^7 are independently hydrogen, C_{1-4} alkyl or C_{1-4} hydroxyalkyl and Z is a suitable anion;

   (c) $N^+(R^5)(R^6)(R^7)CH_2CH(OCOR^1)CH_2(OCOR^2)\ Z^-$

   wherein R^5, R^6, R^7 and Z are as defined above; and

   (d) $N^+(R^5)(R^6)(R^7)CH_2CH_2\text{-}PO_4^-\text{-}CH_2CH(OCOR^1)CH_2(OCOR^2)$

   wherein R^5, R^6, and R^7 are as defined above.

6. The method of claim 5, wherein Z is selected from the group consisting of hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate.

7. The method of claim 6, wherein R^1 and R^2 are independently saturated straight-chain alkyl groups each having about 7 to about 21 carbon atoms.

8. The method of claim 5, wherein the first excipient substance is a phospholipid selected from the group consisting of di-C_{8-22}-alkanoylphosphatidylcholines and di-C_{8-22}-alkanoylphosphatidylethanolamines.

9. The method of claim 8, wherein the first excipient substance is a dipalmitoyl or distearoyl ester of phosphatidylcholine or a mixture thereof.

10. The method of claim 1, wherein said first excipient substance is a quaternary ammonium compound or mixture of such compounds having a hydrophobic moiety that is a saturated alkyl or haloalkyl group having about 6 to about 22 carbon atoms.

11. The method of claim 10, wherein said first excipient substance has the formula

$$R^8\text{-}W_a\text{-}X\text{-}Y_b\text{-}(CH_2)_n\text{-}N^+(R^9)(R^{10})(R^{11})\ T^-$$

wherein R^8 represents said hydrophobic moiety and is a hydrocarbyl or haloalkyl group having from about 6 to about 22 carbon atoms, W and Y are independently O or NH, a and b are independently 0 or 1 but at least one of a and b is 1, X is CO, SO or SO_2, n is 2 to 4, R^9, R^{10} and R^{11} are independently C_{1-4} alkyl, and T is a suitable anion.

12. The method of claim 11, where R^8 is hydrocarbyl and has about 12 to about 18 carbon atoms.

13. The method of claim 11, where R^8 is fluorinated.

14. The method of claim 11, where R^8 is perfluorinated.

15. The method of claim 14, where R^8 has about 6 to about 12 carbon atoms.

16. The method of claim 11, where T is selected from the group consisting of hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate.

17. The method of claim 11, where R^8 is saturated perfluoroalkyl having about 6 to about 12 carbon atoms, X is CO or SO_2, Y is NH, a is 0, b is 1, R^9, R^{10} and R^{11} are methyl, and T is selected from the group consisting of hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate.

18. The method of claim 17, where X is SO_2, n is 3 and T is chloride, bromide or iodide.

19. The method of claim 1, wherein the aqueous composition further comprises a second excipient substance having at least one hydrophobic moiety, wherein if the second excipient substance has one hydrophobic moiety, the hydrophobic moiety is a hydrocarbyl or haloalkyl group having about 6 to about 22 carbon atoms, and wherein if the second excipient substance has a plurality of hydrophobic moieties, each such hydrophobic moiety is a hydrocarbyl or haloalkyl group having more than 2 carbon atoms, said plurality of hydrophobic moieties having a total of about 12 to about 40 carbon atoms.

20. The method of claim 19, wherein said first excipient substance is a liposome-forming substance and said second excipient substance is a quaternary ammonium compound or mixture of such compounds.

21. The method of claim 20, wherein said quaternary ammonium compound has the formula

$$R^8\text{-}W_a\text{-}X\text{-}Y_b\text{-}(CH_2)_n\text{-}N^+(R^9)(R^{10})(R^{11})\ T^-$$

wherein R^8 represents said hydrophobic moiety and is a hydrocarbyl or haloalkyl group having from about 6 to about 22 carbon atoms, W and Y are independently O or NH, a and b are independently 0 or 1 but at least one of a and b is 1, X is CO, SO or SO_2, n is 2 to 4, R^9, R^{10} and R^{11} are independently C_{1-4} alkyl, and T is a suitable anion.

22. The method of claim 21, where R^8 is hydrocarbyl and has about 12 to about 18 carbon atoms.

23. The method of claim 21, where R^8 is fluorinated.

24. The method of claim 21, where R^8 is perfluorinated.

25. The method of claim 24, where R^8 has about 6 to about 12 carbon atoms.

26. The method of claim 21, where T is selected from the group consisting of hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate.

27. The method of claim 21, where R^8 is saturated perfluoroalkyl having about 6 to about 12 carbon atoms, X is CO or SO_2, Y is NH, a is 0, b is 1, R^9, R^{10} and R^{11} are methyl, and T is selected from the group consisting of hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate.

28. The method of claim 27, where X is SO_2, n is 3 and T is chloride, bromide or iodide.

29. The method of claim 19, wherein said first excipient substance is a liposome-forming substance and said second excipient substance is a compound or mixture of compounds of formula

$$R^{14}\text{-CO-A-}R^{15}$$

wherein R^{14} represents said hydrophobic moiety, R^{15} is a C_{1-6} alkyl group and A is O or NH.

30. The method of claim 19, wherein said first excipient substance is a liposome-forming substance and said second excipient substance is a compound or mixture of compounds of formula

$$R^{14}\text{-CO-A-}R^{15}$$

wherein R^{14} is a hydrocarbyl group having about 5 to about 21 carbon atoms, R^{15} is a hydrocarbyl group having 1 to about 14 carbon atoms, the total number of carbon atoms in R^{14} and R^{15} is about 11 to about 27, and A is O or NH.

31. The method of claim 30 wherein R^{14} has about 11 to about 21 carbon atoms, R^{15} has 1 to about 6 carbon atoms and A is O.

32. The method of claim 31 wherein said second excipient substance is a C_{1-4} alkyl ester of a C_{12-18} fatty acid.

33. The method of claim 30 wherein said second excipient substance is a C_{1-4} alkyl ester of a C_{12-18} saturated fatty acid.

34. The method of claim 30 wherein said second excipient substance is a propyl, isopropyl or butyl ester of a C_{12-18} fatty acid.

35. The method of claim 30 wherein said second excipient substance is butyl stearate.

36. The method of claim 1, wherein said first excipient substance is an alkylether surfactant or mixture of such surfactants having the formula

$$R^{12}\text{-O-}(CH_2CH_2O)_n(CH(CH_3)CH_2O)_m\text{-}R^{13}$$

wherein R^{12} is an alkyl or alkenyl group having about 16 to about 22 carbon atoms, n is an average number of about 10 to about 100, m is an average number of 0 to about 5 and R^{13} is hydrogen or C_{1-4} alkyl.

37. The method of claim 36, wherein m is 0 and R^{13} is hydrogen.

38. The method of claim 36, wherein n is from about 20 to about 40.

39. The method of claim 37, wherein R^{12} is a saturated straight-chain alkyl group.

40. The method of claim 39, wherein the alkylether surfactant is a cetyl or stearyl ether or mixture thereof.

41. The method of claim 36, further comprising a second excipient substance which comprises a compound or mixture of compounds of formula

$$R^{14}\text{-CO-A-}R^{15}$$

wherein R^{14} is a hydrocarbyl group having about 5 to about 21 carbon atoms, R^{15} is a hydrocarbyl group having 1 to about 14 carbon atoms, the total number of carbon atoms in R^{14} and R^{15} is about 11 to about 27, and A is O or NH.

42. The method of claim 41 wherein R^{14} has about 11 to about 21 carbon atoms, R^{15} has 1 to about 6 carbon atoms and A is O.

43. The method of claim 42 wherein said second excipient substance is a C_{1-4} alkyl ester of a C_{12-18} fatty acid.

44. The method of claim 42 wherein said second excipient substance is a C_{1-4} alkyl ester of a C_{12-18} saturated fatty acid.

45. The method of claim 42 wherein said second excipient substance is a propyl, isopropyl or butyl ester of a C_{12-18} fatty acid.

46. The method of claim 42 wherein said second excipient substance is butyl stearate.

47. The method of claim 1, where the first excipient substance has a critical packing parameter greater than 1/3.

48. The method of claim 1, wherein the first excipient substance forms aggregates in aqueous solution or dispersion the majority of which are not simple micelles.

49. The method of claim 1 wherein the exogenous chemical is a foliar-applied exogenous chemical.

50. The method of claim 49 wherein the exogenous chemical is a pesticide, gametocide or plant growth regulator.

51. The method of claim 50 wherein the exogenous chemical is a herbicide, nematicide or plant growth regulator.

52. The method of claim 51 wherein the exogenous chemical is a herbicide.

53. The method of claim 52 wherein the herbicide is selected from the group consisting of acetanilides, bipyridyls, cyclohexenones, dinitroanilines, diphenylethers, fatty acids, hydroxybenzonitriles, imidazolinones, phenoxies, phenoxypropionates, substituted ureas, sulfonylureas, thiocarbamates and triazines.

54. The method of claim 52 wherein the herbicide is selected from the group consisting of acetochlor, alachlor, metolachlor, aminotriazole, asulam, bentazon, bialaphos, diquat, paraquat, bromacil, clethodim, sethoxydim, dicamba, diflufenican, pendimethalin, acifluorfen, fomesafen, oxyfluorfen, C_{9-10} fatty acids, fosamine, flupoxam, glufosinate, glyphosate, bromoxynil, imazaquin, imazethapyr, isoxaben, norflurazon, 2,4-D, diclofop, fluazifop, quizalofop, picloram, propanil, fluometuron, isoproturon, chlorimuron, chlorsulfuron, halosulfuron, metsulfuron, primisulfuron, sulfometuron, sulfosulfuron, triallate, atrazine, metribuzin, triclopyr and herbicidal derivatives thereof.

55. The method of claim 54 wherein the herbicide is glyphosate or a herbicidal derivative thereof.

56. The method of claim 55 wherein the herbicide is glyphosate in its acid form.

57. The method of claim 51 wherein the exogenous chemical is water-soluble.

58. The method of claim 57 wherein the exogenous chemical is a salt having an anion portion and a cation portion.

59. The method of claim 58 wherein at least one of said anion and cation portions is biologically active and has a molecular weight of less than about 300.

60. The method of claim 59 wherein the exogenous chemical is paraquat or diquat.

61. The method of claim 59 wherein the exogenous chemical exhibits systemic biological activity in the plant.

62. The method of claim 61 wherein the exogenous chemical has one or more functional groups selected from the group consisting of amine, amide, carboxylate, phosphonate and phosphinate groups.

63. The method of claim 62 wherein the exogenous chemical is a salt of 3,4,4-trifluoro-3-butenoic acid or of N-(3,4,4-trifluoro-1-oxo-3-butenyl)glycine that exhibits nematicidal activity.

64. The method of claim 62 wherein the exogenous chemical is a herbicidal or plant growth regulating compound having at least one of each of amine, carboxylate and either phosphonate or phosphinate functional groups.

65. The method of claim 64 wherein the herbicidal or plant growth regulating compound is a salt of glufosinate.

66. The method of claim 65 wherein the salt of glufosinate is the ammonium salt.

67. The method of claim 64 wherein the herbicidal or plant growth regulating compound is a salt of N-phosphonomethylglycine.

68. The method of claim 67 wherein the salt of N-phosphonomethylglycine is selected from the group consisting of sodium, potassium, ammonium, mono-, di-, tri- and tetra-C_{1-4}-alkylammonium, mono-, di- and tri-C_{1-4}-alkanolammonium, mono-, di- and tri-C_{1-4}-alkylsulfonium and sulfoxonium salts.

69. The method of claim 68 wherein the salt of N-phosphonomethylglycine is the ammonium, monoisopropylammonium or trimethylsulfonium salt.

70. The method of claim 1, where the aqueous composition comprises supramolecular aggregates of the first excipient substance which have an average diameter of at least 20 nm.

71. The method of claim 1, where the aqueous composition comprises supramolecular aggregates of the first excipient substance which have an average diameter of at least 30 nm.

72. The method of claim 41, where the aqueous composition is an emulsion comprising an oil phase that comprises said second excipient substance.

73. The method of claim 72, where the emulsion is a water-in-oil-in-water multiple emulsion.

74. The method of claim 72, wherein the emulsion is an oil-in-water emulsion.

75. The method of claim 1, wherein the aqueous composition on an epicuticular wax layer on a plant surface forms or enlarges hydrophilic channels through the epicuticular wax layer, the hydrophilic channels being capable of transporting the exogenous chemical into the plant more rapidly or more completely than an epicuticular wax layer lacking such formation or enlargement of hydrophilic channels.

76. The method of claim 1, wherein the composition forms an aqueous microdomain in or on an epicuticular wax layer on a plant surface, said first excipient substance in the aqueous microdomain being present as bilayers or multilamellar structures.

77. The method of claim 1, wherein step (b) occurs simultaneously with step (a).

78. The method of claim 77, wherein the exogenous chemical is contained within said aqueous composition.

79. An aqueous composition for application to a plant in conjunction with the application of an exogenous chemical to the plant, comprising:

(a) a first excipient substance that is amphiphilic, and

(b) a second excipient substance having at least one hydrophobic moiety, wherein if the second excipient substance has one hydrophobic moiety, the hydrophobic moiety is a hydrocarbyl or haloalkyl group having about 6 to about 22 carbon atoms, and wherein if the second excipient substance has a plurality of hydrophobic moieties, each such hydrophobic moiety is a hydrocarbyl or haloalkyl group having more than 2 carbon atoms, said plurality of hydrophobic moieties having a total of about 12 to about 40 carbon atoms;

wherein the weight/weight ratio of said first excipient substance to the exogenous chemical is between about 1:3 and about 1:100; and wherein said aqueous composition forms anisotropic aggregates in or on a wax layer.

80. The composition of claim 79, wherein said first excipient substance is a liposome-forming material that comprises an amphiphilic compound or mixture of such compounds having two hydrophobic moieties, each of which is a saturated alkyl or acyl chain having from about 8 to about 22 carbon atoms; wherein said amphiphilic compound or mixture of such compounds having said two hydrophobic moieties constitutes from about 40 to 100 percent by weight of all amphiphilic compounds having two hydrophobic moieties present in said liposome-forming material.

81. The composition of claim 80, wherein the liposome-forming material has a hydrophilic head group comprising a cationic group.

82. The composition of claim 81, wherein the cationic group is an amine or ammonium group.

83. The composition of claim 79, wherein the first excipient substance comprises a liposome-forming compound having a hydrophobic moiety comprising two saturated or unsaturated hydrocarbyl groups R^1 and R^2 each having about 7 to about 21 carbon atoms, said liposome-forming compound having, at a pH of 4, a formula selected from the group consisting of:

(a) $N^+(CH_2R^1)(CH_2R^2)(R^3)(R^4)\ Z^-$

wherein R^3 and R^4 are independently hydrogen, C_{1-4} alkyl or C_{1-4} hydroxyalkyl and Z is a suitable anion;

(b) $N^+(R^5)(R^6)(R^7)CH_2CH(OCH_2R^1)CH_2(OCH_2R^2)\ Z^-$

wherein R^5, R^6 and R^7 are independently hydrogen, C_{1-4} alkyl or C_{1-4} hydroxyalkyl and Z is a suitable anion;

(c) $N^+(R^5)(R^6)(R^7)CH_2CH(OCOR^1)CH_2(OCOR^2)\ Z^-$

wherein R^5, R^6, R^7 and Z are as defined above; and

(d) $N^+(R^5)(R^6)(R^7)CH_2CH_2\text{-}PO_4^-\text{-}CH_2CH(OCOR^1)CH_2(OCOR^2)$

wherein R^5, R^6, and R^7 are as defined above.

84. The composition of claim 83, wherein Z is selected from the group consisting of hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate.

85. The composition of claim 84, wherein R^1 and R^2 are independently saturated straight-chain alkyl groups each having about 7 to about 21 carbon atoms.

86. The composition of claim 83, wherein the first excipient substance is a phospholipid selected from the group consisting of di-C_{8-22}-alkanoylphosphatidylcholines and di-C_{8-22}-alkanoylphosphatidylethanolamines.

87. The composition of claim 86, wherein the first excipient substance is a dipalmitoyl or distearoyl ester of phosphatidylcholine or a mixture thereof.

88. The composition of claim 79, wherein said first excipient substance is a quaternary ammonium compound or mixture of such compounds having a hydrophobic moiety that is a saturated alkyl or haloalkyl group having about 6 to about 22 carbon atoms.

89. The composition of claim 88, wherein said first excipient substance has the formula

$$R^8\text{-}W_a\text{-}X\text{-}Y_b\text{-}(CH_2)_n\text{-}N^+(R^9)(R^{10})(R^{11})\ T^-$$

wherein R^8 represents said hydrophobic moiety and is a hydrocarbyl or haloalkyl group having from about 6 to about 22 carbon atoms, W and Y are independently O or NH, a and b are independently 0 or 1 but at least one of a and b is 1, X is CO, SO or SO_2, n is 2 to 4, R^9, R^{10} and R^{11} are independently C_{1-4} alkyl, and T is a suitable anion.

90. The composition of claim 89, where R^8 is hydrocarbyl and has about 12 to about 18 carbon atoms.

91. The composition of claim 89, where R^8 is fluorinated.

92. The composition of claim 89, where R^8 is perfluorinated.

93. The composition of claim 92, where R^8 has about 6 to about 12 carbon atoms.

94. The composition of claim 89, where T is selected from the group consisting of hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate.

95. The composition of claim 89, where R^8 is saturated perfluoroalkyl having about 6 to about 12 carbon atoms, X is CO or SO_2, Y is NH, a is 0, b is 1, R^9, R^{10} and R^{11} are methyl, and T is selected from the group consisting of hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate.

96. The composition of claim 95, where X is SO_2, n is 3 and T is chloride, bromide or iodide.

97. The composition of claim 79, wherein the second excipient substance has a plurality of hydrophobic moieties, each such hydrophobic moiety being a hydrocarbyl or haloalkyl group having more than 2 carbon atoms, said plurality of hydrophobic moieties having a total of about 12 to about 40 carbon atoms.

98. The composition of claim 79, wherein said first excipient substance is a liposome-forming substance and said second excipient substance is a quaternary ammonium compound or mixture of such compounds.

99. The composition of claim 98, wherein said quaternary ammonium compound has the formula

$$R^8\text{-}W_a\text{-}X\text{-}Y_b\text{-}(CH_2)_n\text{-}N^+(R^9)(R^{10})(R^{11})\ T^-$$

wherein R^8 represents said hydrophobic moiety and is a hydrocarbyl or haloalkyl group having from about 6 to about 22 carbon atoms, W and Y are independently O or NH, a and b are independently 0 or 1 but at least one of a and b is 1, X is CO, SO or SO_2, n is 2 to 4, R^9, R^{10} and R^{11} are independently C_{1-4} alkyl, and T is a suitable anion.

100. The composition of claim 99, where R^8 is hydrocarbyl and has about 12 to about 18 carbon atoms.

101. The composition of claim 99, where R^8 is fluorinated.

102. The composition of claim 99, where R^8 is perfluorinated.

103. The composition of claim 102, where R^8 has about 6 to about 12 carbon atoms.

104. The composition of claim 99, where T is selected from the group consisting of hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate.

105. The composition of claim 99, where R^8 is saturated perfluoroalkyl having about 6 to about 12 carbon atoms, X is CO or SO_2, Y is NH, a is 0, b is 1, R^9, R^{10} and R^{11} are methyl, and T is selected from the group consisting of hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate.

106. The composition of claim 105, where X is SO_2, n is 3 and T is chloride, bromide or iodide.

107. The composition of claim 79, wherein said first excipient substance is a liposome-forming substance and said second excipient substance is a compound or mixture of compounds of formula

$$R^{14}\text{-CO-A-}R^{15}$$

wherein R^{14} represents said hydrophobic moiety, R^{15} is a C_{1-6} alkyl group and A is O or NH.

108. The composition of claim 79, wherein said first excipient substance is a liposome-forming substance and said second excipient substance is a compound or mixture of compounds of formula

$$R^{14}\text{-CO-A-}R^{15}$$

wherein R^{14} is a hydrocarbyl group having about 5 to about 21 carbon atoms, R^{15} is a hydrocarbyl group having 1 to about 14 carbon atoms, the total number of carbon atoms in R^{14} and R^{15} is about 11 to about 27, and A is O or NH.

109. The composition of claim 108 wherein R^{14} has about 11 to about 21 carbon atoms, R^{15} has 1 to about 6 carbon atoms and A is O.

110. The composition of claim 109 wherein said second excipient substance is a C_{1-4} alkyl ester of a C_{12-18} fatty acid.

111. The composition of claim 108 wherein said second excipient substance is a C_{1-4} alkyl ester of a C_{12-18} saturated fatty acid.

112. The composition of claim 108 wherein said second excipient substance is a propyl, isopropyl or butyl ester of a C_{12-18} fatty acid.

113. The composition of claim 108 wherein said second excipient substance is butyl stearate.

114. The composition of claim 79, wherein said first excipient substance is an alkylether surfactant or mixture of such surfactants having the formula

$$R^{12}\text{-O-}(CH_2CH_2O)_n(CH(CH_3)CH_2O)_m\text{-}R^{13}$$

wherein R^{12} is an alkyl or alkenyl group having about 16 to about 22 carbon atoms, n is an average number of about 10 to about 100, m is an average number of 0 to about 5 and R^{13} is hydrogen or C_{1-4} alkyl.

115. The composition of claim 114, wherein m is 0 and R^{13} is hydrogen.

116. The composition of claim 114, wherein n is from about 20 to about 40.

117. The composition of claim 115, wherein R^{12} is a saturated straight-chain alkyl group.

118. The composition of claim 117, wherein the alkylether surfactant is a cetyl or stearyl ether or mixture thereof.

119. The composition of claim 114, further comprising a second excipient substance which comprises a compound or mixture of compounds of formula

$$R^{14}\text{-CO-A-}R^{15}$$

wherein R^{14} is a hydrocarbyl group having about 5 to about 21 carbon atoms, R^{15} is a hydrocarbyl group having 1 to about 14 carbon atoms, the total number of carbon atoms in R^{14} and R^{15} is about 11 to about 27, and A is O or NH.

120. The composition of claim 119 wherein R^{14} has about 11 to about 21 carbon atoms, R^{15} has 1 to about 6 carbon atoms and A is O.

121. The composition of claim 120 wherein said second excipient substance is a C_{1-4} alkyl ester of a C_{12-18} fatty acid.

122. The composition of claim 120 wherein said second excipient substance is a C_{1-4} alkyl ester of a C_{12-18} saturated fatty acid.

123. The composition of claim 120 wherein said second excipient substance is a propyl, isopropyl or butyl ester of a C_{12-18} fatty acid.

124. The composition of claim 120 wherein said second excipient substance is butyl stearate.

125. The composition of claim 79, where the first excipient substance has a critical packing parameter greater than 1/3.

126. The composition of claim 79, wherein the first excipient substance forms aggregates in aqueous solution or dispersion the majority of which are not simple micelles.

127. The composition of claim 79 wherein the exogenous chemical is a foliar-applied exogenous chemical.

128. The composition of claim 79, where the aqueous composition comprises supramolecular aggregates of the first excipient substance which have an average diameter of at least 20 nm.

129. The composition of claim 79, where the aqueous composition comprises supramolecular aggregates of the first excipient substance which have an average diameter of at least 30 nm.

130. The composition of claim 119, where the aqueous composition is an emulsion comprising an oil phase that comprises said second excipient substance.

131. The composition of claim 130, where the emulsion is a water-in-oil-in-water multiple emulsion.

132. The composition of claim 130, wherein the emulsion is an oil-in-water emulsion.

133. The composition of claim 79, wherein the aqueous composition on an epicuticular wax layer on a plant surface forms or enlarges hydrophilic channels through the epicuticular wax layer, the hydrophilic channels being capable of transporting the exogenous chemical into the plant more rapidly or more completely than an epicuticular wax layer lacking such formation or enlargement of hydrophilic channels.

134. The composition of claim 79, wherein the composition forms an aqueous microdomain in or on an epicuticular wax layer on a plant surface, said first excipient substance in the aqueous microdomain being present as bilayers or multilamellar structures.

135. A plant treatment composition comprising

(a) an exogenous chemical, and

(b) a first excipient substance that is amphiphilic;

wherein the weight/weight ratio of said first excipient substance to the exogenous chemical is between about 1:3 and about 1:100; and wherein in presence of water said composition forms anisotropic aggregates in or on a wax layer.

136. The composition of Claim 135, further comprising water in an amount effective to make the composition a dilute aqueous composition ready for application to foliage of a plant.

137. The composition of Claim 135, wherein the composition is a shelf-stable concentrate composition comprising the exogenous chemical substance in an amount of about 15 to about 90 percent by weight.

138. The composition of Claim 137, wherein the composition is a solid composition comprising the exogenous chemical substance in an amount of about 30 to about 90 percent by weight.

139. The composition of Claim 138, wherein the composition is a water-soluble or water-dispersible granular formulation.

140. The composition of Claim 137, further comprising a liquid diluent, and wherein the composition comprises the exogenous chemical substance in an amount of about 15 to about 60 percent by weight.

141. The composition of Claim 140 wherein the exogenous chemical substance is water-soluble and is present in an aqueous phase of the composition in an amount of about 15 to about 45 percent by weight of the composition.

142. The composition of Claim 141, wherein the composition is an aqueous solution concentrate.

143. The composition of Claim 141, wherein the composition is an emulsion having an oil phase.

144. The composition of Claim 143, wherein the composition is an oil-in-water emulsion.

145. The composition of Claim 143, wherein the composition is a water-in-oil emulsion.

146. The composition of Claim 143, wherein the composition is a water-in-oil-in-water multiple emulsion.

147. The composition of Claim 141, further comprising a solid inorganic particulate colloidal material.

148. The composition of claim 136, where the composition comprises supramolecular aggregates of the first excipient substance which have an average diameter of at least 20 nm.

149. The composition of claim 136, where the composition comprises supramolecular aggregates of the first excipient substance which have an average diameter of at least 30 nm.

150. The composition of claim 135, wherein the composition in the presence of water on an epicuticular wax layer on a plant surface forms or enlarges hydrophilic channels through the epicuticular wax layer, the hydrophilic channels being capable of transporting the exogenous chemical into the plant more rapidly or more completely than an epicuticular wax layer lacking such formation or enlargement of hydrophilic channels.

151. The composition of claim 135, wherein the composition in the presence of water in or on an epicuticular wax layer on a plant surface forms an aqueous microdomain, said first excipient substance in the aqueous microdomain being present as bilayers or multilamellar structures.

152. The composition of claim 135, wherein said first excipient substance is a liposome-forming material that comprises an amphiphilic compound or mixture of such compounds having two hydrophobic moieties, each of which is a saturated alkyl or acyl chain having from about 8 to about 22 carbon atoms; wherein said amphiphilic compound or mixture of such compounds having said two hydrophobic moieties constitutes from about 40 to 100 percent by weight of all amphiphilic compounds having two hydrophobic moieties present in said liposome-forming material.

153. The composition of claim 152, wherein the liposome-forming material has a hydrophilic head group comprising a cationic group.

154. The composition of claim 153, wherein the cationic group is an amine or ammonium group.

155. The composition of claim 135, wherein the first excipient substance comprises a liposome-forming compound having a hydrophobic moiety comprising two saturated or unsaturated hydrocarbyl groups R^1 and R^2 each having about 7 to about 21 carbon atoms, said liposome-forming compound having, at a pH of 4, a formula selected from the group consisting of:

(a) $N^+(CH_2R^1)(CH_2R^2)(R^3)(R^4)\ Z^-$

wherein R^3 and R^4 are independently hydrogen, C_{1-4} alkyl or C_{1-4} hydroxyalkyl and Z is a suitable anion;

(b) $N^+(R^5)(R^6)(R^7)CH_2CH(OCH_2R^1)CH_2(OCH_2R^2)\ Z^-$

wherein R^5, R^6 and R^7 are independently hydrogen, C_{1-4} alkyl or C_{1-4} hydroxyalkyl and Z is a suitable anion;

(c) $N^+(R^5)(R^6)(R^7)CH_2CH(OCOR^1)CH_2(OCOR^2)\ Z^-$

wherein R^5, R^6, R^7 and Z are as defined above; and

(d) $N^+(R^5)(R^6)(R^7)CH_2CH_2\text{-}PO_4^-\text{-}CH_2CH(OCOR^1)CH_2(OCOR^2)$

wherein R^5, R^6, and R^7 are as defined above.

156. The composition of claim 155, wherein Z is selected from the group consisting of hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate.

157. The composition of claim 156, wherein R^1 and R^2 are independently saturated straight-chain alkyl groups each having about 7 to about 21 carbon atoms.

158. The composition of claim 155, wherein the first excipient substance is a phospholipid selected from the group consisting of di-C_{8-22}-alkanoylphosphatidylcholines and di-C_{8-22}-alkanoylphosphatidylethanolamines.

159. The composition of claim 158, wherein the first excipient substance is a dipalmitoyl or distearoyl ester of phosphatidylcholine or a mixture thereof.

160. The composition of claim 135, wherein said first excipient substance is a quaternary ammonium compound or mixture of such compounds having a hydrophobic moiety that is a saturated alkyl or haloalkyl group having about 6 to about 22 carbon atoms.

161. The composition of claim 160, wherein said first excipient substance has the formula

$$R^8\text{-}W_a\text{-}X\text{-}Y_b\text{-}(CH_2)_n\text{-}N^+(R^9)(R^{10})(R^{11})\ T^-$$

wherein R^8 represents said hydrophobic moiety and is a hydrocarbyl or haloalkyl group having from about 6 to about 22 carbon atoms, W and Y are independently O or NH, a and b are independently 0 or 1 but at least one of a and b is 1, X is CO, SO or SO_2, n is 2 to 4, R^9, R^{10} and R^{11} are independently C_{1-4} alkyl, and T is a suitable anion.

162. The composition of claim 161, where R^8 is hydrocarbyl and has about 12 to about 18 carbon atoms.

163. The composition of claim 161, where R^8 is fluorinated.

164. The composition of claim 161, where R^8 is perfluorinated.

165. The composition of claim 164, where R^8 has about 6 to about 12 carbon atoms.

166. The composition of claim 161, where T is selected from the group consisting of hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate.

167. The composition of claim 161, where R^8 is saturated perfluoroalkyl having about 6 to about 12 carbon atoms, X is CO or SO_2, Y is NH, a is 0, b is 1, R^9, R^{10} and R^{11} are methyl, and T is selected from the group consisting of hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate.

168. The composition of claim 167, where X is SO_2, n is 3 and T is chloride, bromide or iodide.

169. The composition of claim 135, wherein the aqueous composition further comprises a second excipient substance having at least one hydrophobic moiety, wherein if the second excipient substance has one hydrophobic moiety, the hydrophobic moiety is a hydrocarbyl or haloalkyl group having about 6 to about 22 carbon atoms, and wherein if the second excipient substance has a plurality of hydrophobic moieties, each such hydrophobic moiety is a hydrocarbyl or haloalkyl group having more than 2 carbon atoms, said plurality of hydrophobic moieties having a total of about 12 to about 40 carbon atoms.

170. The composition of claim 169, wherein said first excipient substance is a liposome-forming substance and said second excipient substance is a quaternary ammonium compound or mixture of such compounds.

171. The composition of claim 170, wherein said quaternary ammonium compound has the formula

$$R^8\text{-}W_a\text{-}X\text{-}Y_b\text{-}(CH_2)_n\text{-}N^+(R^9)(R^{10})(R^{11})\ T^-$$

wherein R^8 represents said hydrophobic moiety and is a hydrocarbyl or haloalkyl group having from about 6 to about 22 carbon atoms, W and Y are independently O or NH, a and b are independently 0 or 1 but at least one of a and b is 1, X is CO, SO or SO_2, n is 2 to 4, R^9, R^{10} and R^{11} are independently C_{1-4} alkyl, and T is a suitable anion.

172. The composition of claim 171, where R^8 is hydrocarbyl and has about 12 to about 18 carbon atoms.

173. The composition of claim 171, where R^8 is fluorinated.

174. The composition of claim 171, where R^8 is perfluorinated.

175. The composition of claim 174, where R^8 has about 6 to about 12 carbon atoms.

176. The composition of claim 171, where T is selected from the group consisting of hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate.

177. The composition of claim 171, where R^8 is saturated perfluoroalkyl having about 6 to about 12 carbon atoms, X is CO or SO_2, Y is NH, a is 0, b is 1, R^9, R^{10} and R^{11} are methyl, and T is selected from the group consisting of hydroxide, chloride, bromide, iodide, sulfate, phosphate and acetate.

178. The composition of claim 177, where X is SO_2, n is 3 and T is chloride, bromide or iodide.

179. The composition of claim 169, wherein said first excipient substance is a liposome-forming substance and said second excipient substance is a compound or mixture of compounds of formula

$$R^{14}\text{-CO-A-}R^{15}$$

wherein R^{14} represents said hydrophobic moiety, R^{15} is a C_{1-6} alkyl group and A is O or NH.

180. The composition of claim 169, wherein said first excipient substance is a liposome-forming substance and said second excipient substance is a compound or mixture of compounds of formula

$$R^{14}\text{-CO-A-}R^{15}$$

wherein R^{14} is a hydrocarbyl group having about 5 to about 21 carbon atoms, R^{15} is a hydrocarbyl group having 1 to about 14 carbon atoms, the total number of carbon atoms in R^{14} and R^{15} is about 11 to about 27, and A is O or NH.

181. The composition of claim 180 wherein R^{14} has about 11 to about 21 carbon atoms, R^{15} has 1 to about 6 carbon atoms and A is O.

182. The composition of claim 181 wherein said second excipient substance is a C_{1-4} alkyl ester of a C_{12-18} fatty acid.

183. The composition of claim 180 wherein said second excipient substance is a C_{1-4} alkyl ester of a C_{12-18} saturated fatty acid.

184. The composition of claim 180 wherein said second excipient substance is a propyl, isopropyl or butyl ester of a C_{12-18} fatty acid.

185. The composition of claim 180 wherein said second excipient substance is butyl stearate.

186. The composition of claim 135, wherein said first excipient substance is an alkylether surfactant or mixture of such surfactants having the formula

$R^{12}\text{-O-}(CH_2CH_2O)_n(CH(CH_3)CH_2O)_m\text{-}R^{13}$

wherein R^{12} is an alkyl or alkenyl group having about 16 to about 22 carbon atoms, n is an average number of about 10 to about 100, m is an average number of 0 to about 5 and R^{13} is hydrogen or C_{1-4} alkyl.

187. The composition of claim 186, wherein m is 0 and R^{13} is hydrogen.

188. The composition of claim 186, wherein n is from about 20 to about 40.

189. The composition of claim 187, wherein R^{12} is a saturated straight-chain alkyl group.

190. The composition of claim 189, wherein the alkylether surfactant is a cetyl or stearyl ether or mixture thereof.

191. The composition of claim 186, further comprising a second excipient substance which comprises a compound or mixture of compounds of formula

$R^{14}\text{-CO-A-}R^{15}$

wherein R^{14} is a hydrocarbyl group having about 5 to about 21 carbon atoms, R^{15} is a hydrocarbyl group having 1 to about 14 carbon atoms, the total number of carbon atoms in R^{14} and R^{15} is about 11 to about 27, and A is O or NH.

192. The composition of claim 191 wherein R^{14} has about 11 to about 21 carbon atoms, R^{15} has 1 to about 6 carbon atoms and A is O.

193. The composition of claim 192 wherein said second excipient substance is a C_{1-4} alkyl ester of a C_{12-18} fatty acid.

194. The composition of claim 192 wherein said second excipient substance is a C_{1-4} alkyl ester of a C_{12-18} saturated fatty acid.

195. The composition of claim 192 wherein said second excipient substance is a propyl, isopropyl or butyl ester of a C_{12-18} fatty acid.

196. The composition of claim 192 wherein said second excipient substance is butyl stearate.

197. The composition of claim 135, where the first excipient substance has a critical packing parameter greater than 1/3.

198. The composition of claim 135, wherein the first excipient substance forms aggregates in aqueous solution or dispersion the majority of which are not simple micelles.

199. The composition of claim 135 wherein the exogenous chemical is a foliar-applied exogenous chemical.

200. The composition of claim 199 wherein the exogenous chemical is a pesticide, gametocide or plant growth regulator.

201. The composition of claim 200 wherein the exogenous chemical is a herbicide, nematicide or plant growth regulator.

202. The composition of claim 201 wherein the exogenous chemical is a herbicide.

203. The composition of claim 202 wherein the herbicide is selected from the group consisting of acetanilides, bipyridyls, cyclohexenones, dinitroanilines, diphenylethers, fatty acids, hydroxybenzonitriles, imidazolinones, phenoxies, phenoxypropionates, substituted ureas, sulfonylureas, thiocarbamates and triazines.

204. The composition of claim 202 wherein the herbicide is selected from the group consisting of acetochlor, alachlor, metolachlor, aminotriazole, asulam, bentazon, bialaphos, diquat, paraquat, bromacil, clethodim, sethoxydim, dicamba, diflufenican, pendimethalin, acifluorfen, C_{9-10} fatty acids, fomesafen, oxyfluorfen, fosamine, flupoxam, glufosinate, glyphosate, bromoxynil, imazaquin, imazethapyr, isoxaben, norflurazon, 2,4-D, diclofop, fluazifop, quizalofop, picloram, propanil, fluometuron, isoproturon, chlorimuron, chlorsulfuron, halosulfuron, metsulfuron, primisulfuron, sulfometuron, sulfosulfuron, triallate, atrazine, metribuzin, triclopyr and herbicidal derivatives thereof.

205. The composition of claim 204 wherein the herbicide is glyphosate or a herbicidal derivative thereof.

206. The composition of claim 205 wherein the herbicide is glyphosate in its acid form.

207. The composition of claim 201 wherein the exogenous chemical is water-soluble.

208. The composition of claim 207 wherein the exogenous chemical is a salt having an anion portion and a cation portion.

209. The composition of claim 208 wherein at least one of said anion and cation portions is biologically active and has a molecular weight of less than about 300.

210. The composition of claim 209 wherein the exogenous chemical is paraquat or diquat.

211. The composition of claim 209 wherein the exogenous chemical exhibits systemic biological activity in the plant.

212. The composition of claim 211 wherein the exogenous chemical has one or more functional groups selected from the group consisting of amine, amide, carboxylate, phosphonate and phosphinate groups.

213. The composition of claim 212 wherein the exogenous chemical is a salt of 3,4,4-trifluoro-3-butenoic acid or of N-(3,4,4-trifluoro-1-oxo-3-butenyl)glycine that exhibits nematicidal activity.

214. The composition of claim 212 wherein the exogenous chemical is a herbicidal or plant growth regulating compound having at least one of each of amine, carboxylate and either phosphonate or phosphinate functional groups.

215. The composition of claim 214 wherein the herbicidal or plant growth regulating compound is a salt of glufosinate.

216. The composition of claim 215 wherein the salt of glufosinate is the ammonium salt.

217. The composition of claim 214 wherein the herbicidal or plant growth regulating compound is a salt of N-phosphonomethylglycine.

218. The composition of claim 217 wherein the salt of N-phosphonomethylglycine is selected from the group consisting of sodium, potassium, ammonium, mono-, di-, tri- and tetra-C_{1-4}-alkylammonium, mono-, di- and tri-C_{1-4}-alkanolammonium, mono-, di- and tri-C_{1-4}-alkylsulfonium and sulfoxonium salts.

219. The composition of claim 218 wherein the salt of N-phosphonomethylglycine is the ammonium, monoisopropylammonium or trimethylsulfonium salt.

220. The composition of claim 135, where the aqueous composition comprises supramolecular aggregates of the first excipient substance which have an average diameter of at least 20 nm.

221. The composition of claim 135, where the aqueous composition comprises supramolecular aggregates of the first excipient substance which have an average diameter of at least 30 nm.

222. The composition of claim 191, where the aqueous composition is an emulsion comprising an oil phase that comprises said second excipient substance.

223. The composition of claim 222, where the emulsion is a water-in-oil-in-water multiple emulsion.

224. The composition of claim 222, wherein the emulsion is an oil-in-water emulsion.

225. A plant treatment method, comprising the step of contacting foliage of the plant with a biologically effective amount of a composition according to any of claims 135, 136, or 148 to 224.

226. A method for enhancing the yield of a field crop comprising the steps of:

(a) planting a crop in a field,

(b) substantially freeing the field of one or more weed species that would diminish the yield of the crop by applying to the weed species a herbicidally effective amount of a composition that comprises (i) a foliar herbicide, (ii) an aqueous diluent, (iii) a first excipient substance that is amphiphilic;

wherein the weight/weight ratio of said first excipient substance to the exogenous chemical is between about 1:3 and about 1:100; and wherein said composition forms anisotropic aggregates in or on a wax layer;

(c) allowing the crop to mature, and

(d) harvesting the crop.

227. A method of enhancing the yield of a field crop comprising the steps of:

(a) substantially freeing a field of one or more weed species that would diminish the yield of the crop by applying to the weed species a herbicidally effective amount of a composition that comprises (i) a foliar herbicide, (ii) an aqueous diluent, (iii) a first excipient substance that is amphiphilic;

wherein the weight/weight ratio of said first excipient substance to the exogenous chemical is between about 1:3 and about 1:100; and wherein said composition forms anisotropic aggregates in or on a wax layer;

(b) planting the crop in the field,

(c) allowing the crop to mature, and

(d) harvesting the crop.

228. A plant treatment method, comprising contacting the foliage with a composition comprising

(a) water,

(b) a biologically effective amount of the exogenous chemical, and

(c) a first excipient substance that is amphiphilic;

wherein the weight/weight ratio of said first excipient substance to the exogenous chemical is between about 1:3 and about 1:100; and wherein said composition forms anisotropic aggregates in or on a wax layer, and wherein the biological effectiveness of the composition is greater than that of otherwise similar compositions that do not form such anisotropic aggregates.

229. The method of claim 10 wherein the first excipient substance is Fluorad FC-135 or Fluorad FC-754.

230. The method of claim 20 wherein the second excipient substance is Fluorad FC-135 or Fluorad FC-754.

231. The composition of claim 88 wherein the first excipient substance is Fluorad FC-135 or Fluorad FC-754.

232. The composition of claim 98 wherein the second excipient substance is Fluorad FC-135 or Fluorad FC-754.

233. The composition of claim 160 wherein the first excipient substance is Fluorad FC-135 or Fluorad FC-754.

234. The composition of claim 170 wherein the second excipient substance is Fluorad FC-135 or Fluorad FC-754.

235. An in vitro assay method for selecting an exogenous chemical composition having enhanced biological effectiveness when applied to plants, comprising the steps of:

(1) providing a glass microscope slide coated with a thin, uniform layer of wax, such that the wax layer on the slide exhibits a dark field when illuminated by transmitted polarized light and examined through a microscope,

(2) preparing a sample of an aqueous solution or dispersion of an exogenous chemical composition, diluted or concentrated if necessary such that the concentration of exogenous chemical is about 15% to about 20% by weight of the composition,

(3) positioning the slide on a stage of a microscope that transmits polarized light through the slide,

(4) placing a drop of the sample on the wax layer to form an assay slide,

(5) maintaining the assay slide at approximately ambient temperature for a period of about 5 to about 20 minutes,

(6) determining at the end of said period whether when transmitting polarized light the locus of the drop on the assay slide displays birefringence, and

(7) selecting for biological evaluation a composition wherein birefringence is displayed.

236. An in vitro assay method for selecting a composition of an excipient substance providing enhanced biological effectiveness of an exogenous chemical when applied therewith to plants, comprising the steps of:

(1) providing a glass microscope slide coated with a thin, uniform layer of wax, such that the wax layer on the slide exhibits a dark field when illuminated by transmitted polarized light and examined through a microscope,

(2) preparing a sample of an aqueous solution or dispersion of a composition of an excipient substance, diluted or concentrated if necessary such that the concentration of excipient substance is about 5% to about 7% by weight of the composition,

(3) positioning the slide on a stage of a microscope that transmits polarized light through the slide,

(4) placing a drop of the sample on the wax layer to form an assay slide,

(5) maintaining the assay slide at approximately ambient temperature for a period of about 5 to about 20 minutes,

(6) determining at the end of said period whether when transmitting polarized light the locus of the drop on the assay slide displays birefringence, and

(7) selecting for biological evaluation a composition wherein birefringence is displayed.

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A01N25/30 A01N57/20 A01N25/04 A01N25/28 G01N21/84

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 32 26 498 A (NATTERMANN A & CIE) 19 January 1984 see page 19 - page 22, line 2 and page 22, lines 17-19 and page 23, lines 34-36 see page 33, line 1 - line 7 see page 41, line 12 - line 13 see page 62, line 11 - page 64; claims; examples ---	1-10,19, 47-71, 75-88, 97, 125-129, 133-160, 169, 197-221, 225-228

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

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Date of the actual completion of the international search	Date of mailing of the international search report
17 March 1998	27/03/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Muellners, W

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X	EP 0 082 437 A (NATTERMANN A & CIE) 29 June 1983	1-10,19, 47-56, 70,71, 75-88, 97, 125-129, 133-135, 137, 148-160, 169, 197-206
X	see page 6, line 31 - line 34; example 10 see page 5, line 10 - line 21 see page 1 - page 4, line 20 ---	220,221, 225-228
X	EP 0 099 029 A (NATTERMANN A & CIE) 25 January 1984	1-10,19, 29-34, 47-53, 70,71, 75-88, 97, 107-112, 125-129, 133-135, 137,140
X	see page 1 - page 3, line 23; example 5 ---	148-160, 169, 179-184, 197-203, 220,221, 225-228

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International Application No
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X	see page 5, line 21 - page 7, line 23	152-162, 169-172, 197-204, 207-209, 211,212, 214,220, 221, 225-228
	see page 18 - page 24; claim 1 ---	
X	CHEMICAL ABSTRACTS, vol. 109, no. 23, 5 December 1988 Columbus, Ohio, US; abstract no. 206676, ROBERT L. GLASS: "Entrapment of herbicides '14C!picloram and '14C!dicamba in phospholipid vesicles" XP002058784	1-10,19, 47-52, 54,57, 135,136, 148-160, 169, 197-202, 204,207, 220,221
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X	see page 1 - page 3; claims; example 1; table II	152-157, 160,169, 170, 199-202, 204,205, 207-209, 211-214, 217,218, 225-228

A	WYRILL J B ET AL: "GLYPHOSATE TOXICITY TO COMMON MILKWEED AND HEMP DOGBANE AS INFLUENCED BY SURFACTANTS" WEED SCIENCE, vol. 25, no. 3, May 1977, pages 275-287, XP002034447 see the whole document	1-234
X	see page 276, the table, third and forth entry from the bottom and page 284, table 6	1-7,10, 19, 49-52, 54,55, 57-59, 61,62, 64, 67-69, 77,78, 135,136, 152-157, 160

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X	see page 3 - page 4, line 40	125-129, 133-137, 148-157, 160,169, 186,187, 197-221, 225-228
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X	EP 0 394 211 A (MONSANTO CO) 24 October 1990	1,10-19, 47-71, 77-79, 88-97, 125-129, 133-139, 148-151, 160-169, 197-221
X	see page 3, line 45 - line 57	225-229, 231,233
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	see page 1, line 66 - line 78 see page 3, line 5 - line 21 ---	

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Category	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	WO 95 12977 A (MONSANTO CO ;AHLGRIM JEANETTE TRACY (US); KASSEBAUM JAMES WEB (US)) 18 May 1995	1,19, 36-40, 47-51, 57-59, 61-63, 70,71, 75-79, 97, 114-118, 125-129
X	see page 1 - page 4	133-146, 148-151, 169, 186-190, 197-201, 207-209, 211-213, 220,221, 225-228
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X	see page 1, paragraph 3 - paragraph 6	125-137, 140, 148-151, 169,186, 187, 191-193, 195, 197-204, 220-228
	see page 3, penultimate paragraph see page 7, paragraph 3 - page 8, paragraph 1; examples 1,5-8 ---	

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International Application No
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X	see page 1, line 1 - line 10	125-129, 133-135, 137-139, 169, 186-190, 197-202, 204,205, 207-209, 211,212
X	see page 3, line 21 - page 5, line 15	214, 216-221, 225-228
	see page 7, line 3 - line 14; examples V,VII,X; tables I,II ---	
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X	see page 3, line 10 - line 31	125-129, 133-135, 137-139, 169, 186-190, 197-202, 204-209, 211,212, 214
X	see page 4, line 27 - line 34	220,221, 225-228
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X	see page 7, line 21 - page 8, line 39	117, 125-129, 133-142, 148-151, 169,186, 187,189, 197-202, 204,205
X	see page 12, line 5 - page 13, line 4; example 4	207-209, 211,212, 214, 216-221, 225-228

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X	see claims	207-209, 211,212, 214,220, 221, 225-228
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X	see page 2 - page 6, line 11; claims; examples	197-205, 207-209, 211,212, 214-221, 225-228
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A	DE 32 47 050 A (BAYER AG) 20 June 1984 see page 11 - page 12, paragraph 1 see page 18, last paragraph - page 20, paragraph 1 see page 22, paragraph 2; claims; examples ---	41-46, 119-124, 191-196
A	CHEMICAL ABSTRACTS, vol. 120, no. 21, 23 May 1994 Columbus, Ohio, US; abstract no. 263749, SERRE, I. ET AL: "seed oil derivatives as adjuvants: influence of methyl to octadecyl oleates on the penetration of herbicides through various plant cuticles" XP002059248 see abstract & MEDED. - FAC. LANDBOUWKD. TOEGEPASTE BIOL. WET. (UNIV. GENT) (1993), 58(3A), 795-802 CODEN: MFLBER, 1993, ---	41-46, 119-124, 191-196
A	R.F.NORRIS & M.J.BUKOVAC: "Structure of the pear leaf cuticle with special reference to cuticular penetration " AMERICAN JOURNAL OF BOTANY , vol. 55, no. 8, 1968, pages 975-83, XP002059060 see the whole document -----	75,76, 133,134, 150,151, 235,236

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